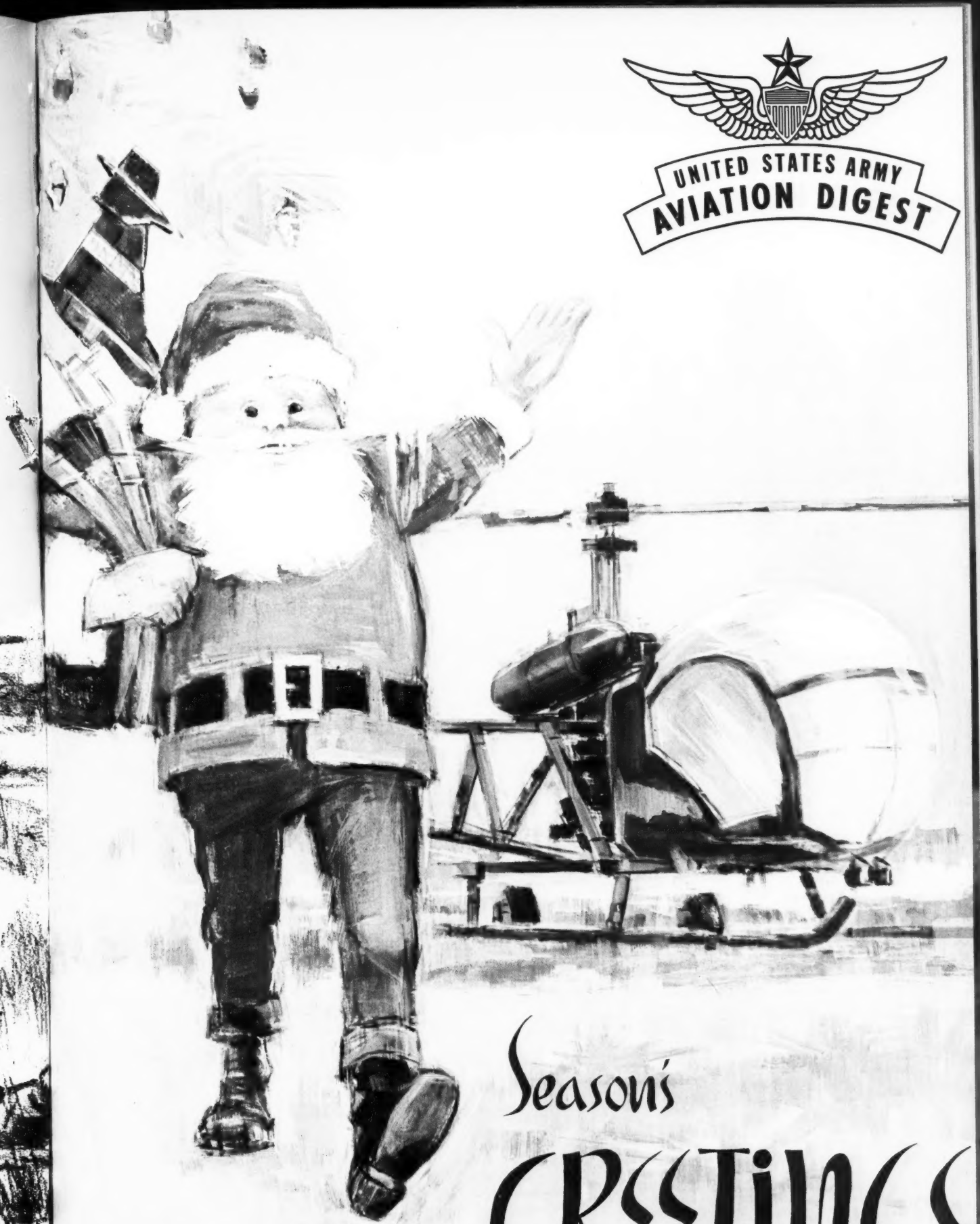
UNITED STATES ARMY
AVIATION DIGEST



Season's
GREETINGS

DECEMBER 1963

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Photo on page 1
Miss Peggy Ann Ray, courtesy of Grumman Aircraft Engineering Corporation.

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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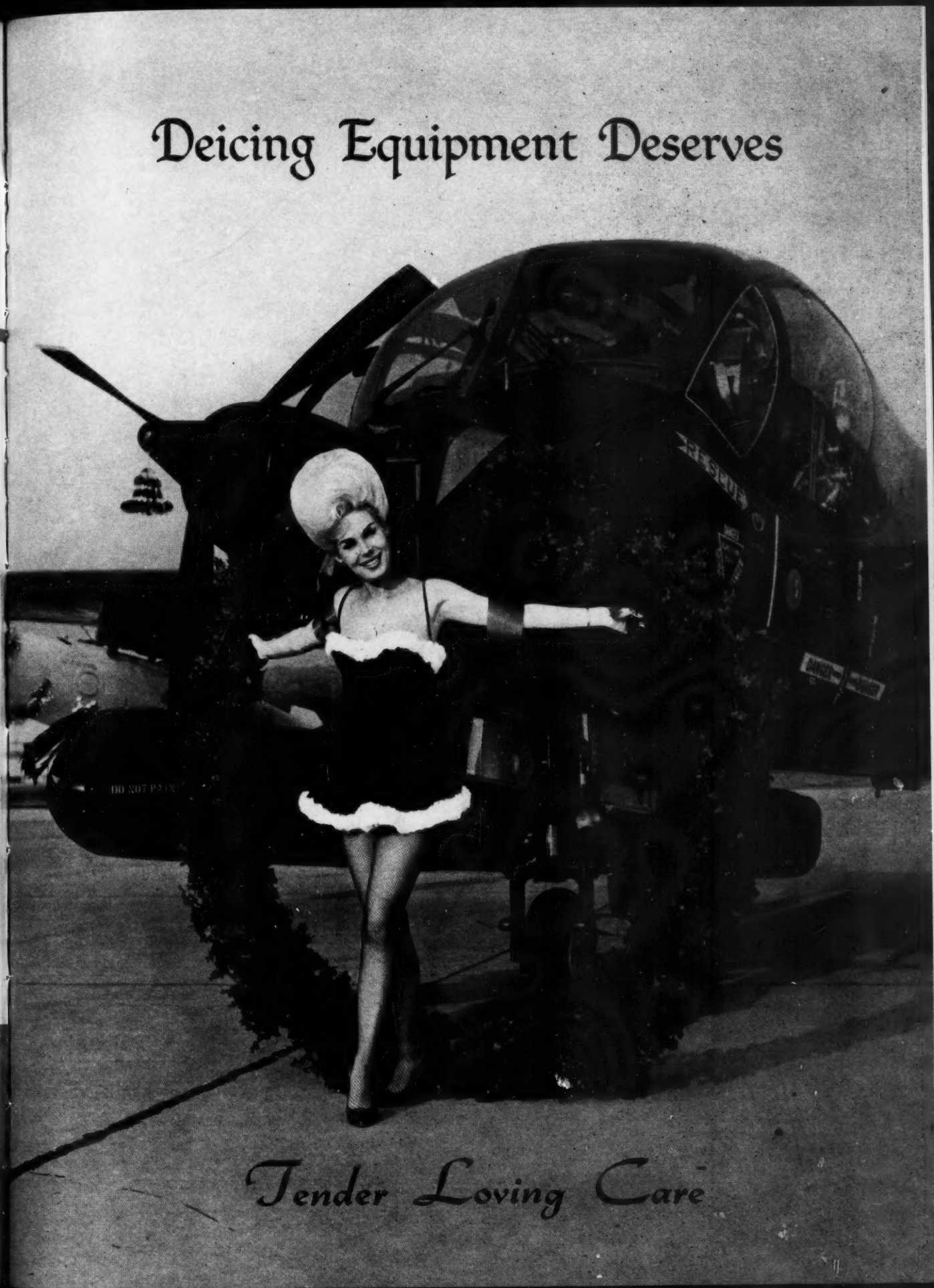


VSTOL

The question of which is the best power-plant system may not be resolved for some time as at this present state of development one can only say there will be room for several configurations, with the proviso that there is more than one engine. On safety grounds this is important—not only at the point of transition, but also during normal flight at low altitude where bird ingestion is a real hazard, and this applies also to non-VTOL aircraft. More than one engine enables the aircraft to complete its mission and return to base, whereas experience has shown that very expensive aircraft and sometimes pilots have been lost due to the failure of the sole means of propulsion.

Powerplants

From a paper by R. W. Harker and A. J. Heyworth, D.F.C., A.F.R.Ae.S.

Prototype flights by the Balzac, P 1127, the VJ 101 [and the Lockheed Hummingbird] have shown that VTOL works. Aircraft have been proved stable under hovering flight and the general handling is quite acceptable, but what we need to know is how to *operate* V/STOL aircraft—how and where aircraft should be dispersed and how deployed in relation to the prevailing environment. Until a squadron can fly them and in practice evolve an operational pattern, taking into account such things as ground erosion, maintenance of weapon system, serviceability, etc., progress will be retarded. The nine P 1127 aircraft being built for the tripartite U. S./Germany/Britain agreement should be of great value in this field.

The choice of powerplant for VTOL aircraft is one which is not easy to arrive at without very careful study of the work that has already been done, study of the prototype aircraft now flying, and the reasons their various systems have been chosen. A comprehensive assessment of the present position, however, should lead the designer to reach a solution for the next generation of aircraft which will provide safety, operational efficiency, and practical simplicity, so the resultant aircraft will be satisfactory in service under all operational conditions.

The way things have gone in Europe is interesting, as Britain started by supporting the mixed powerplant system in the Short SC 1, then for certain reasons began to favour the single-engine vectored thrust concept.

On the other hand, studies were done independently in France, Germany, and Italy and these have materialised in projects being built embodying the mixed powerplant concept—notably the Mirage 3V and the VJ 101—while there are several others on the drawing board, such as the Fiat G 95, etc. In the States, Bell started with a VTOL flat riser and this was followed by the Ryan/Rolls-Royce powered swivelling jet tail sitter, and now every conceivable combination is being investigated. This is good, as at this stage of the art, one must study all methods, and research should proceed on a broad front until the right system emerges for the particular type of aircraft under consideration.

Looking to the future, it is hard to say what the optimum system of engines might be. It was originally conceived that a large number of small liftjets would be, in theory, the most efficient way to do the job, but the number quoted was considered impractical for operational use.

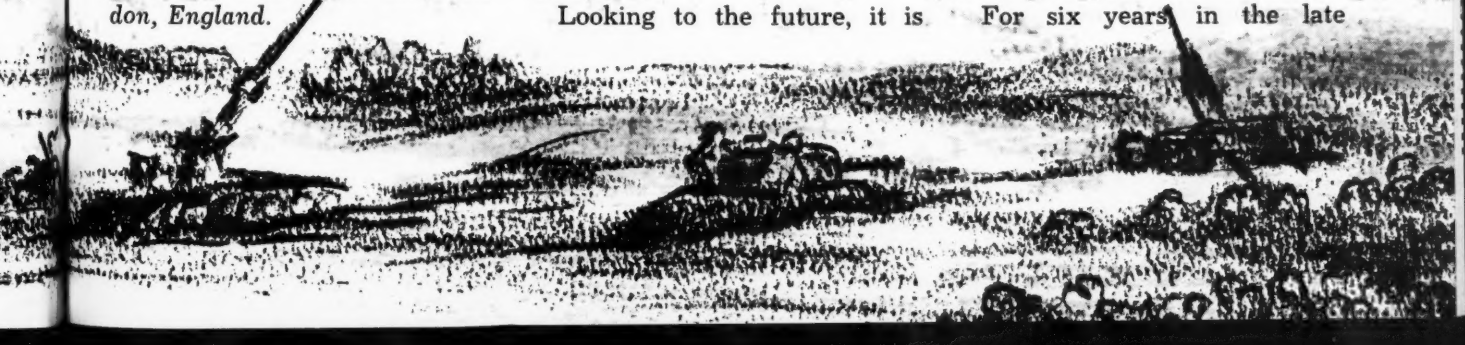
The pendulum then swung to the other extreme when a certain school of thought considered only one engine to be the right answer. Time will show that there will be an ideal solution between the two extremes which will give the best compromise under operational conditions.

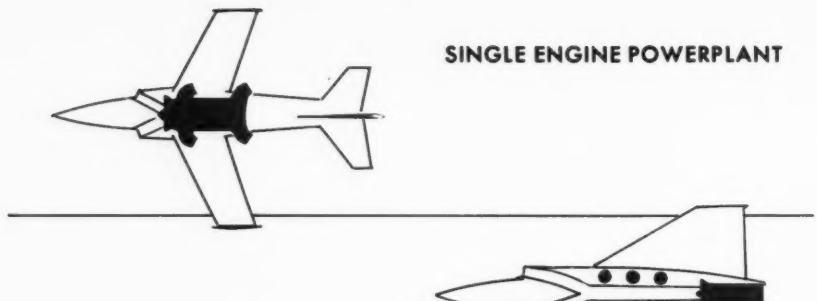
The original proposal for the use of jet lift in an aircraft was the means to an end and not an end in itself. Twenty years ago at Rolls-Royce the potential of the jet engine was considered to be so great that jet lift could replace wing lift at low forward speed, thus permitting the aircraft designer freedom to design the wing for high speed flight only. No design compromise would be required for takeoff and landing, thus making a highly efficient aircraft.

The compromise of low speed flight characteristics, including flaps, leading edge slots, etc., need no longer exist if jet lift is used. VTOL was a by-product of an efficient powerplant system for high speed aircraft.

For six years in the late

Mr. Harker is Advisor to the Chief Executive on Military Operations, and Mr. Heyworth is Manager, Engineering Operations, for Rolls-Royce Ltd, London, England.





V/STOL vehicles are successfully operating today. They hold the promise of even greater tactical flexibility and application than is now available with STOL aircraft. But what will the ultimate V/STOL look like? Will it have one engine? Or two? Or more?

1940's, our long term project group carried out a complete assessment of jet lift. In the early studies the same engine was used for both propulsion and lift, but later it was concluded that the most efficient jet lift powerplant system for high speed aircraft must use specialised lightweight lift jets to obtain the necessary thrust response for the VTOL phase and to allow the propulsion to be optimised for the mission.

The main difference of opinion in the United Kingdom revolves round the point as to whether the same engine should be used for lift as well as propulsion, or whether the engine should be ideally sized for the aircraft and mission and have specialised liftjets added to give the required lift. Separate studies have been carried out in North America and it is believed that many of these support the conclusions formed by the great majority of European aircraft manufacturers, who have selected the composite powerplant as the most efficient system for VTOL strike and transport aircraft.

There is still some doubt as to the best powerplant solution for a subsonic Army aircraft with an observation and surveillance mission. Does this mission include a period of slow flying or even hover, because the mission dictates the size of the fan.

For example, the helicopter with the large diameter rotor is the most economical method of hovering, whereas the small diameter liftjet has a high fuel consumption which does not permit prolonged hover conditions. A compromise is obtained by selecting fans of increasing bypass ratio as the requirement for hover or slow flying time is increased during the mission.

If liftjets are added to give an aircraft VTOL characteristics, it is understood that they will only be used for a very short duration during the takeoff and landing phase, although there is no mechanical reason why they should not be run for prolonged periods.

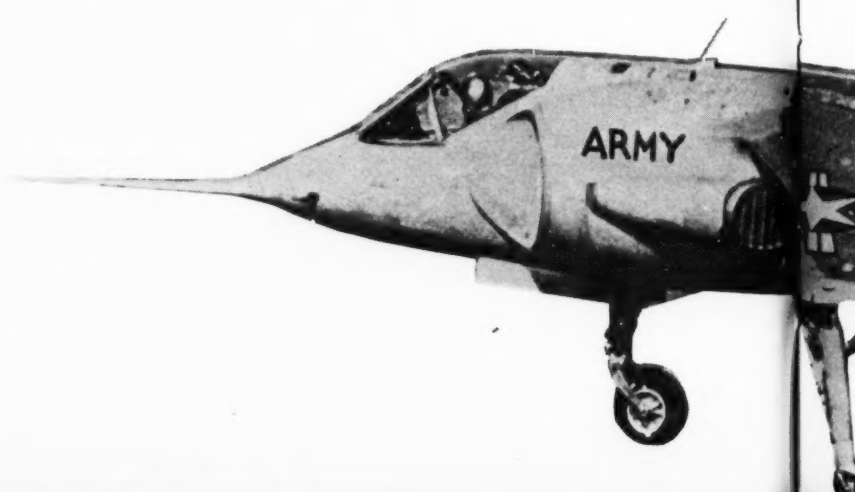
In addition to the ducted fan in wing aircraft, other powerplant schemes for an Army VTOL aircraft include the single lift/thrust engine in the 1127 aircraft already flying, a proposed aircraft with twin lift/thrust engines, and a project with a lift/cruise engine plus two or more liftjets or liftfans.

Whilst it can be shown that the composite powerplant gives a lighter aircraft for a strike mission, the customer has to consider the problem areas during operation as well as aircraft/engine efficiency.

LIFTFAN OR LIFTJET

Although many military V/STOL studies have been carried out, aircraft manufacturers have not stated any firm requirements for liftfans.

The fuel consumption of a liftjet during transition is a very small percentage of the total fuel used during the mission. Reduction of fuel consumption by



means of a liftfan is offset by other factors which have an adverse effect on the overall economics of the aircraft, for example, the large volume of the unit, the lower power to weight ratio, the low response rate and momentum drag.

However, for certain applications, such as a subsonic VTOL transport aircraft, the lower fuel consumption offered by a liftfan may be more attractive. In this case the best solution would entail the use of the correct fan diameter for the installation. This can be achieved by adding the optimum size of front fan to a proven gas producer, such as an RB 162 liftjet.

Definitions

V/STOL is defined as the ability of an aircraft to take off and land on a strip 500 feet in length with a 50-foot screen at either end.

The flight path during transition depends on the thrust to weight ratio of the aircraft and/or the ground terrain.

Lift/Cruise Engine. A propulsion engine optimised for the cruise phase of the mission. The available thrust is deflected to give some lift during takeoff and landing.

Lift/Thrust Engine. An engine providing enough thrust to lift the aircraft vertically. The same engine is used for propulsion in normal flight.

Liftjet. A lightweight turbojet designed specifically for the takeoff and landing phase.

Liftfan. A lightweight turbofan or bypass jet designed specifically for the takeoff and landing phase.

Composite Powerplant. A propulsion engine (with or without thrust deflection) ideally sized for the aircraft and mission; liftjets or liftfans added to give *V/STOL.*

Ducted Fan. This applies to the fan-in-wing concept where the fan is shaft- or jet-driven by a turbojet.

Puff pipe control. Engine bleed air fed via ducts to stabilising nozzles situated on the wing tips, nose and tail of the aircraft.

FUTURE LIFTJETS AND LIFTFANS

Continuous improvement in thrust/weight ratio has been achieved by liftjets. The RB 162 has established a thrust to weight ratio of 16:1 and will be in service operation by 1966. It will be superseded by a still more advanced third generation liftjet having a thrust to weight ratio of over 20:1.

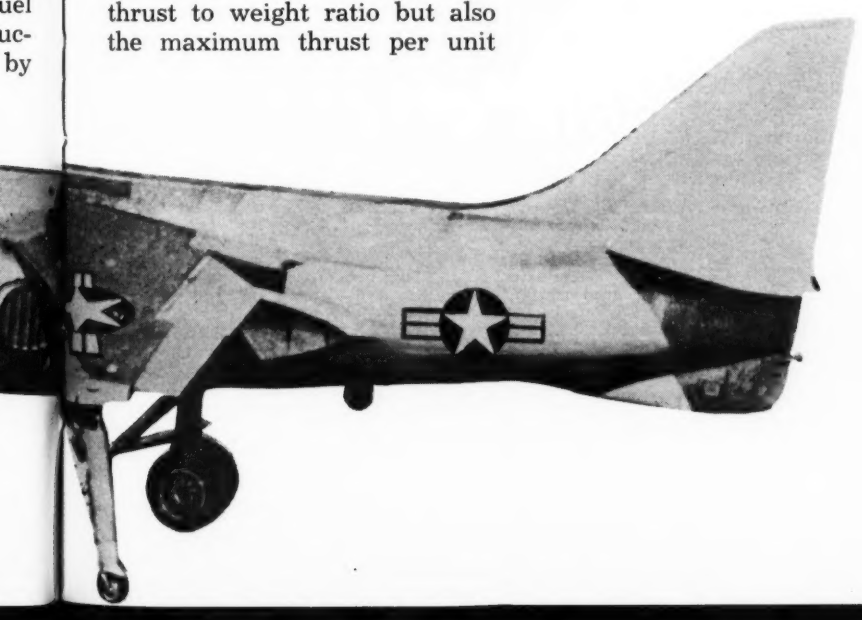
More than twenty aircraft projects using the RB 162 liftjet have been thoroughly studied and important installational factors brought to light. Of these, the most important is the achievement of not only high thrust to weight ratio but also the maximum thrust per unit engine volume ratio. Liftjet project studies have shown considerable reductions in the volume of the basic engine.

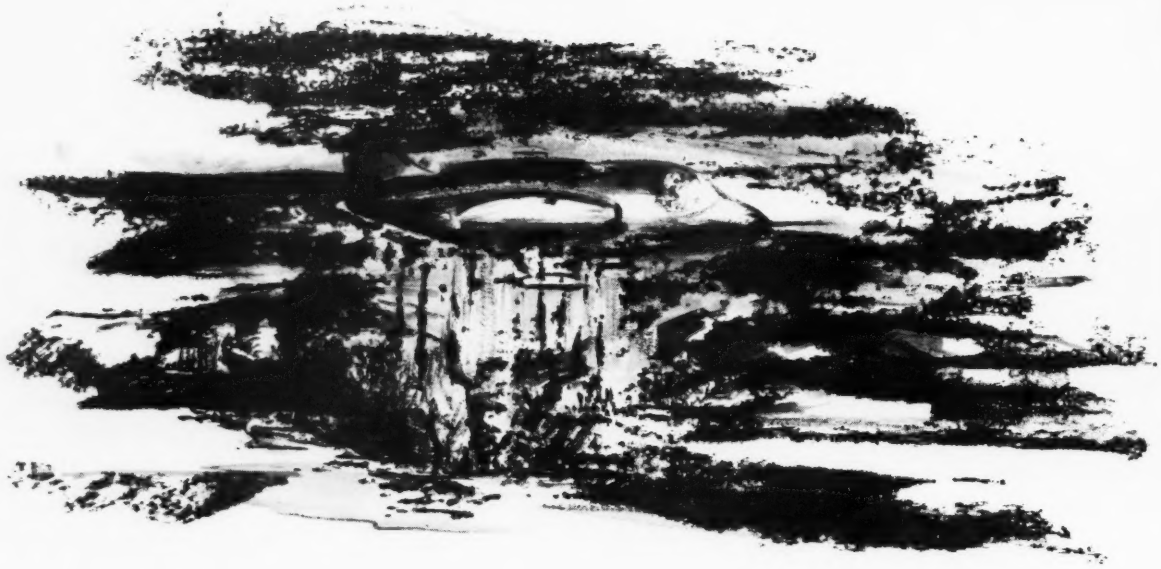
POWERPLANT MAINTENANCE

The twin lift/thrust engine installation will probably use four swivelling nozzles, so these and their control systems will require inspection in addition to the normal engine maintenance, particularly as they are in operation during the whole flight.

The liftjets of a composite powerplant are in operation for very short periods at low altitude during each flight and consequently have a long installed life. The design philosophy of the RB 162 has been simplicity and reduction in the number of components and variables.

A periodical inspection every 100 aircraft hours will include a visual gas leakage check, a functional igniter check, and inspection of the single fuel filter. Engine change for overhaul will be carried out quickly by the use of an automatic coupling system, and liftjet installation time will be 15 minutes.





Experience has shown that a bank of liftjets requires no more maintenance than a conventional propulsion engine. It is also interesting to note that liftjets which have been installed in VTO aircraft for the past five years have been completely reliable in their operation and every air start has been successful.

DUCTED FANS

Whilst a twin engine installation driving ducted fans in the wings and nose is being investigated in the U.S.A., not much work has been done in Europe on this type of project and therefore no worthwhile contribution can be made to this discussion.

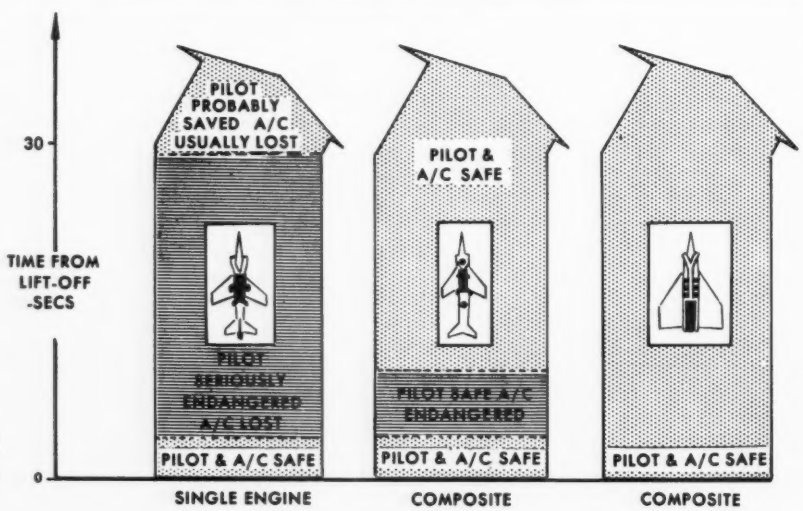
However, thought is being given to ducted fans for VTOL civil transport aircraft where low jet velocity, and therefore noise level, is important.

SWIVELLING PODS

Very close cooperation between EWR Sud in Germany and Rolls-Royce has resulted in the successful flight trials of the VJ 101C. Two pairs of engines are mounted in pods on the wing tips for propulsion. These pods are swivelled to the vertical position for lift, and additional lift thrust is supplied by two liftjets. As the jets are arranged in a triangular pattern, roll and pitch control is obtained by differential throttling and yaw control by swivelling the pods in opposite directions. Some consider this to be an ideal arrangement for the composite powerplant for the following reasons:

1. Total installed power available for VTOL.
2. No thrust loss due to deflection.
3. No thrust loss due to air bleed for puff pipe control.
4. Control nozzles and lengthy duct system for puff pipe control are not required.
5. Plenty of space in the fuse-

ENGINE FAILURE AFTER LIFT-OFF



lage for fuel or weapons.
6. Favourable design weight due to simple airframe structure.

SAFETY OF AIRCRAFT AND PILOT

There are two phases of flight to cover, firstly the mission, secondly the takeoff, landing and transition phase. In both cases the failure of the single lift/thrust engine usually results in loss of the aircraft and with it possibly the pilot (see illustration).

If a twin lift/thrust aircraft is considered, the safety aspect changes completely because, firstly, the aircraft has mission return capability, and, secondly, if one power unit fails during transition enough bleed air will remain available for puff pipe control, thus maintaining control and stability.

When the number of power units is increased as in the composite powerplant, the chance of damaging the aircraft during transition becomes remote as only a small proportion of thrust is lost.

A further contribution to safety with the composite powerplant is the use of emergency thrust ratings for the liftjets to be used only after a power unit failure.

During the mission should a propulsion engine fail, the liftjets can be lit in flight and used to get you home; the chance of carrying out a safe landing would depend on the number of liftjets in the powerplant system and the landing area available.

However, the ability to bring the pilot home from a mission and the cost of a combat aircraft warrants careful consideration when selecting the type of powerplant system to meet the requirement.

For Army surveillance the twin lift/thrust system has many attractions at first sight, but nevertheless it is believed that in the end the composite powerplant, the system which gives the best performance, will be favoured.

There is more work to do, and above all, discussions and arguments giving the different angles which can throw light on the choice of powerplant systems for V/STOL aircraft must continue.

Killer Underwear

Major James E. Hertzog

PROTECTIVE clothing—one of man's basic necessities—is a critical item of equipment for Army Aviators, *but it can be a killer!*

A few years ago the warmest underwear known to man was the red flannel unionsuit. These "Long Johns" are a far cry from the thermal type underwear marketed today.

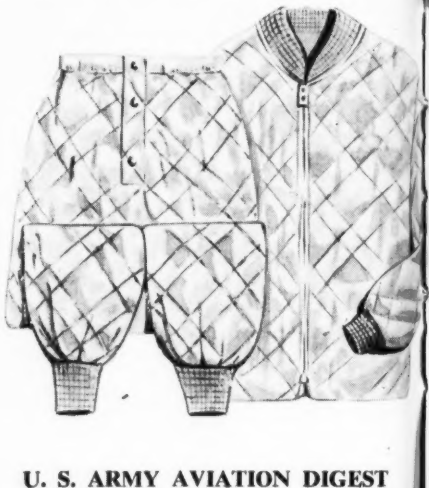
Thermal underwear uses the principle of dead airspace to seal out cold and retain body heat. Lightweight and comfortable, it does an excellent job of keeping the wearer warm and allowing mobility. On the surface it seems that this is the ideal undergarment for Army Aviators.

However, thermal underwear of poor quality and design and improperly used may not only be ineffective but may actually create a fire hazard to the aviator.

To understand why this hazard exists it is necessary to study the various kinds of thermal underwear offered. Dozens of combinations of fabric, style, and quality are produced. Yet, each manufacturer makes his thermal underwear a little different. However, generally speaking, three different types are on the market.

One style looks very much like regular underwear and is made of woven cotton in a three dimensional waffle weave.

Another type is made of polyester fiber batts quilted between lightweight nylon. Usually offered in a jacket and trouser combination style, it can be worn over regular underwear;



Maj Hertzog is a flight surgeon and Chief, Aeromedical Education and Training, U. S. Army Hospital, Ft Rucker, Ala.

In aviation, we tend to think of protective clothing in terms of crash helmets, flight suits, gloves, and footgear—all items of frequent discussion and proposed improvement. Yet, other less dramatic but important items deserve our consideration. One of these is protective underclothing.

the jacket can be worn over a regular shirt or underneath a coat or other garment.

The third type is made of wool fleece batts or down quilted between combed cotton or nylon cloth. It is generally produced in the combination jacket and trouser style.

In considering the fire hazard of insulated underwear, the cotton waffle weave and wool or down fill quilted material is safest to wear under normal conditions encountered by outdoor workers and sportsmen. These materials are no more flammable than everyday cotton clothing.

The quilted polyester fiber, nylon shell-jacket and pants

type of insulated underwear does not catch fire any easier than those made of cotton or wool. However, once it starts to burn, the nylon and polyester fiber melts to form a hot, sticky plastic which adheres to the skin. This can cause serious burns, and therefore is not safe under even normal conditions.

For aviators, the ideal form of thermal u derclothing does not exist. The two-piece quilted nylon polyester fiber type is both comfortable and a good insulator, but it is dangerous because of its melting and adhering characteristics. Wool fleece batts are also good insulators, but wool is often irritating to the skin. Single or double thickness cotton is comfortable, but its high absorbency (good in some cases) presents another problem. It is seldom that fuel does not spill in an aircraft crash, and the danger is that the cotton underwear may absorb this fuel and turn the aviator into a torch.

The aviator's thermal underwear should be made of non-irritating, low absorbent, non-flammable material. Made in an easily removable, two-piece style, it should be relatively loose fitting except at the cuffs and neckline. It should provide adequate insulation within a moderate range of temperatures.

The only thermal underwear that comes anywhere near to these requirements is the type with wool fleece batts or down, quilted between cotton or nylon cloth. This garment will fulfill the criteria of insulation and protection against burns. Its irritating characteristics are minimized by the outside layer of cotton or nylon cloth.

Army Aviators don't need to be experts on fabrics or styles, but they should recognize that their safety might depend on basic safety knowledge of these subjects. That underwear could be a killer!

NEW HORIZONS FOR ARMY AVIATORS

Leo F. McDonald

AROUND THE WORLD in 80 minutes? Not yet for most Army Aviators, but it's possible today—if you fly around the world close to either pole! The Army Aviation horizon is visibly expanding to encompass vast new areas of experience for today's pilots. With this growth, come new problems to be faced—in training, technique, and equipment.

Already, Army Aviation has extensive operations in Alaska; "chopper" pilots are engaged in mapping Antarctica; and ferry hops of the Caribou across the North Atlantic have become commonplace. Are you ready for such an assignment? Are you prepared for polar or high latitude operation?

Conventional man has lived in a "rectangular world." Usually, he has thought of the north-south meridians as being parallel to each other and perpendicular to the east-west parallels of latitude, the two forming the familiar Mercator graticule. Directions measured relative to the meridians and maintained by a magnetic compass have seemed adequate. For practical purposes, a "straight line" on a chart has meant a "rhumb line" (a path over the earth that cuts every meridian at the same angle), the course provided by the magnetic compass when "variation" is applied.

In temperate latitudes, celestial bodies rise in the east and set in the west. The sun divides the day naturally into two roughly equal periods of daylight and darkness, separated by relatively short transitional periods of twilight. The hour of the

Mr. McDonald is assigned to the U. S. Army Electronic Proving Ground, Fort Huachuca, Ariz.

day is associated with this diurnal motion of the sun.

In higher latitudes or polar regions conditions are much different. Here the pole is a great hub from which the meridians radiate like spokes of a giant wheel. It is the center of a family of concentric circles constituting the parallels of latitude. A person can go "around the world" in the sense that he crosses all meridians in a matter of hours or even minutes. The usual convention of direction is quite inadequate because of the rapid convergence of the meridians. The magnetic compass becomes less useful, in fact absolutely useless, at the geographic poles. At the North Pole, every direction is south; at the South Pole, every direction is north.

In this area, stars circle the sky without noticeable change in altitude. The sun rises late in March (in the Northern hemisphere), slowly spiralling to its maximum altitude and then spiralling back to the horizon six months after rising. Because of our limited knowledge of refractions, and abnormal refraction does exist here, men have been known to wager on what particular day the sun would rise. Twilight lasts for several weeks. The moon rises and sets about once a month.

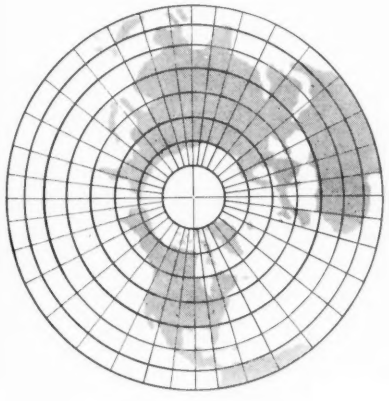
Pilots of the Army's first helicopters to reach the South Pole no doubt encountered navigational problems such as those discussed

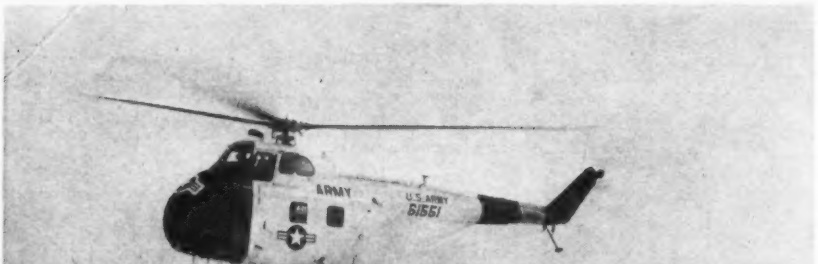
This area will be a new world to the Army Aviator as far as things being different from those he is accustomed to in lower latitudes. His maps, although accurate as to the latitude and longitude graticule, will be lacking in much detail. In some instances what detail is included may be inaccurately placed because of inadequate surveys of the area. Radio aids will be practically nonexistent, although those present might be more powerful and useful for greater distances. Because of occasional severe magnetic storms, complete radio blackout may exist for hours or even days.

Radio bearings will take on a new significance. These bearings are of course great circles and their variance from the familiar rhumb line are more exaggerated. For example at 70° North latitude, a great circle over the earth will change true direction approximately 0.94° for every degree of longitude along its path (difference in longitude X sine of latitude). If a powerful radiobeacon were located at 70°N, 42° 45′W and an aircraft located at 70°N, 50°W (a distance of approximately 150 nautical miles), an ADF in the aircraft would indicate a bearing of 085°. If the above positions were reversed, the ADF would indicate a bearing of 275°. From this it is easily seen that these are not reciprocal bearings. Thus, attempting to obtain a fix by plotting the bearings to two stations becomes quite dangerous if the beacons are very far away. The bearings given by the ADF are from the aircraft to the station, and if we do not know where we are, we do not know which meridian to use as a reference to plot these bearings. We cannot plot the reciprocal bearings from the station as we can with negligible error in lower latitudes.

Before venturing into this new

Lambert Equal Area Projection. A mathematically designed azimuthal equal-area projection. It is excellent for continental areas. For larger areas away from center, distortion of distances and shapes is appreciable.





If your next assignment is in a polar region, do you know all you should about its peculiar navigational problems?

environment, the Army Aviator should familiarize himself with all the established techniques and possibly devise new ones peculiar to his type of mission. He should become an expert on map projections, knowing what type path over the earth is portrayed by a straight line on each, as well as their advantages and limitations. Are the available charts adequate for his needs? Does all of the sophisticated equipment about to become available to him solve all his problems? Does he understand their optimum use?

In the past, the Army Aviator has had neither the aircraft nor the necessary instruments to allow him to venture safely into high latitudes. Conventional methods of navigation, using a stabilized magnetic compass, were sufficient to get him anywhere he wanted to go. Whether he used a Mercator or Lambert Conformal chart was immaterial; a straight line on either would approximate a rhumb line in the lower latitudes. Both provided him a sufficient picture of the land below, allowing him to combine pilotage, dead reckoning, and radio to obtain as accurate navigation as he needed. These conditions will not exist much longer.

Industry has made much progress in miniaturizing navigation equipment, and today Army aircraft are on the threshold of being as well instrumented as many of the heavier aircraft of the Air Force and Navy. Lightweight gyromagnetic compass systems (with magnetic slaved and directional gyro modes), Doppler navigation systems, and absolute altimeters are now being tested at the U. S. Army Electronic Proving Ground, Fort Huachuca, Ariz. No doubt they will soon find their way into Army aircraft as standard equipment.

The compass systems mentioned above may very well be the most important of these items. These systems with a usable directional gyro mode of operation will give Army aircraft a completely new capability. The Army Aviator will have a directional reference that will allow him to follow a great circle path over the earth. The directional gyro mode has provisions for correcting for the apparent wander due to the rotation of the earth (approximately 15° per hour X sine of latitude), and the random drift rate remaining is probably on the order of ½° per hour, thus giving a reliable heading reference.

Although it is generally desirable to fly great circle routes because the great circle is the shortest distance between two points on the surface of the earth, the magnetic slaved mode of operation should not be discarded; it is very useful in certain areas of high latitude. The saving in distance by flying a great circle route instead of a rhumb line path is not great (even in high latitudes) if the flight is for a relatively short distance, such as 300 nautical miles.

In some places on the earth it would be impossible to use the magnetic compass as a directional reference, and a grid system of navigation using the directional gyro would be a must; however, on a similar flight in other areas at the same latitude, either type of heading reference could be used. For example, if a flight were to be made (disregarding wind) from 70°N, 110°W to 70°N, 95° 24′W (a distance of approximately 300 nautical miles), a directional gyro would probably have to be used because the flight is in the vicinity of the north magnetic pole and the magnetic compass would be unreliable. However, if the 300-mile flight were from 70°N, 80°E to 70°N, 94° 36′E, a considerable distance from the magnetic pole, either heading reference could be used equally well.

In the latter flight, if a directional gyro were used as the heading reference (again disregarding wind), the gyro heading would be a constant 083°, while the true heading would vary from 083° to 097°. If the magnetic heading were used, of

course the true heading would remain a constant 090°, and probably an average variation could be used. The saving in distance by flying a great circle would be very small, only about two nautical miles. Notice, however, that two distinct paths over the earth would be followed to reach the same destination, the first being a great circle slightly north of the 70th parallel and the second directly along the 70th parallel.

The type of heading reference is also an important item in any Doppler navigation system. Doppler systems that provide a continuous display of latitude and longitude coordinates generally are designed to accept a true heading input. If a "directional gyro" is used, of course the computer cannot provide the correct latitude and longitude unless some provision is made for processing the effect of meridian convergency so that a continuously changing true heading can be fed to the computer.

Another problem involving a latitude-longitude display would be met in high latitudes. A high-speed aircraft might be crossing meridians so fast that the longitude display would be virtually meaningless. Some grid system with probably along track and cross tract coordinates provided must be used. Here again it is very important to know whether your intended track is a great circle or a rhumb line.

The absolute altimeters, although their primary use is to give the height above the terrain, can be used as navigational equipment when used in conjunction with the barometric altimeter, especially on long overwater hops. When flying a constant "pressure altitude" (with 29.92 as the barometric altimeter setting), the fall or rise of the absolute altitude will indicate whether the aircraft is entering a low or high pressure area, and thus tell the pilot whether he's drifting right or left. Additional refinements in this pressure pattern technique can be used to obtain a fairly accurate estimate of how many miles the aircraft is off course to the right or left. It is not suggested that this method be used as a primary means of navigation, but it can certainly be a valuable crosscheck against the Doppler, and possibly a lifesaver in emergencies.

Polar or high-latitude navigation need not be any more difficult than ordinary navigation. It simply means that by knowing your job better and being aware of your equipment's capabilities and limitations, you can better use this equipment and safely fly anywhere over the earth. Many standard works exist on recognized high-latitude techniques. It may be time well-spent to read them.

Navigation in high latitude or polar areas can be as simple as anywhere, providing you know your equipment and its capabilities.

Tomcat Eyes

William H. Smith

MY WIFE LIKES to kid me about my night vision. She says I have none. So when one of our children wants a drink of water or the cat wants out, she attends to it. She doesn't want me to stumble over something and get hurt.

To tell the truth, I've kind of fostered this idea. It sure beats getting up in a cold room on a dark night. But if my ever loving learns the facts about seeing at night, she'll probably play 'possum while I stumble around.

Some aviators are in the same class; they don't know much about night vision. Even worse, they don't realize there is something to learn about it.

From the moment you climb into an aircraft until you climb out, you depend on your eyes. This is especially true at night.

Of course, you'll never be able to see at night as well as a tomcat, but you can learn to do a better job. To improve your night vision, you should be aware of these three reasons why it's harder to see at night:

- Your mind and eyes work together. To see well, especially at night, you must concentrate and put effort into it.
- Your eyes are built in such a way that you must use them one way in the day and another way at night.
- Things look different at night than they do in the daytime.

Let's look at the first reason carefully: your mind and eyes must work as a team. If your eyes are looking at one thing and your mind is on something else, you are not aware of much. This is especially true at night. Or, as we used to say, you are gazing into space. But if someone talks to you or something else happens to arouse you, you immediately jump to and can see again.

Even with your attention on seeing, only a few things can enter the mind's eye at one time. If you are flying along looking for enemy supply trucks, you probably won't see that antenna sticking out of the woods. If you are looking for a radio antenna, those supply trucks have time to duck.

So what does all this add up to? It simply means that you must know what you are looking for, and you must keep your mind on it.

Now, about this business of your eyes and their construction The light sensitive nerve endings at the back of your eyes consist of cones and rods. Cones are concentrated in the center area while rods are concentrated in a ring around the cones. You use cones to see color and detail and to pick up faraway objects. Rods, on the other hand, see color only as shades of gray. You use them to see out of the corners of your eyes. They don't pick up details but do catch objects in motion.

Broadly speaking, you see with cones in the day and rods at night. In daylight, cones do most of the work. In full moonlight, cones and rods divide the work. In starlight, cones quit work and rods take over.

When you go from a brightly

lighted room into the dark, you can't see anything until your eyes adjust to the change. First, the pupils open to let in all the light present. Then the cones begin to adjust to the darkness. After about 7 minutes, your eyes have become 100 times more sensitive and you can see a little. The rods adjust more slowly, but when they have become dark adapted, they increase in sensitivity about 100,000 times. This takes time—at least 30 minutes for the rods.

When you go from the dark to bright light, your eyes adjust quickly. Ten seconds of bright light will destroy much of your ability to see in the dark and you must start dark adaptation all over again. Therefore, it is necessary to adapt your eyes to the dark and keep them that way.

The simplest way is to sit in the dark for the full 30 minutes. This can be boring. However, the use of red light can permit activity while allowing dark adaptation. Cones can see in red light, but rods react much the same as they do in the dark. If you stay in a red lighted room or use red goggles in lighted rooms, you can see with your cones while your rods are adapting to the dark.

Red light is no more dangerous to your eyes than looking at a pretty redheaded girl. The only disadvantage is that you won't be able to see any red markings on a chart. In red light, red markings tend to look white.

Adapting your eyes is only one of the techniques you must learn. When something catches your eyes, you normally look in that direction to see what it is. This is all right in the daytime.

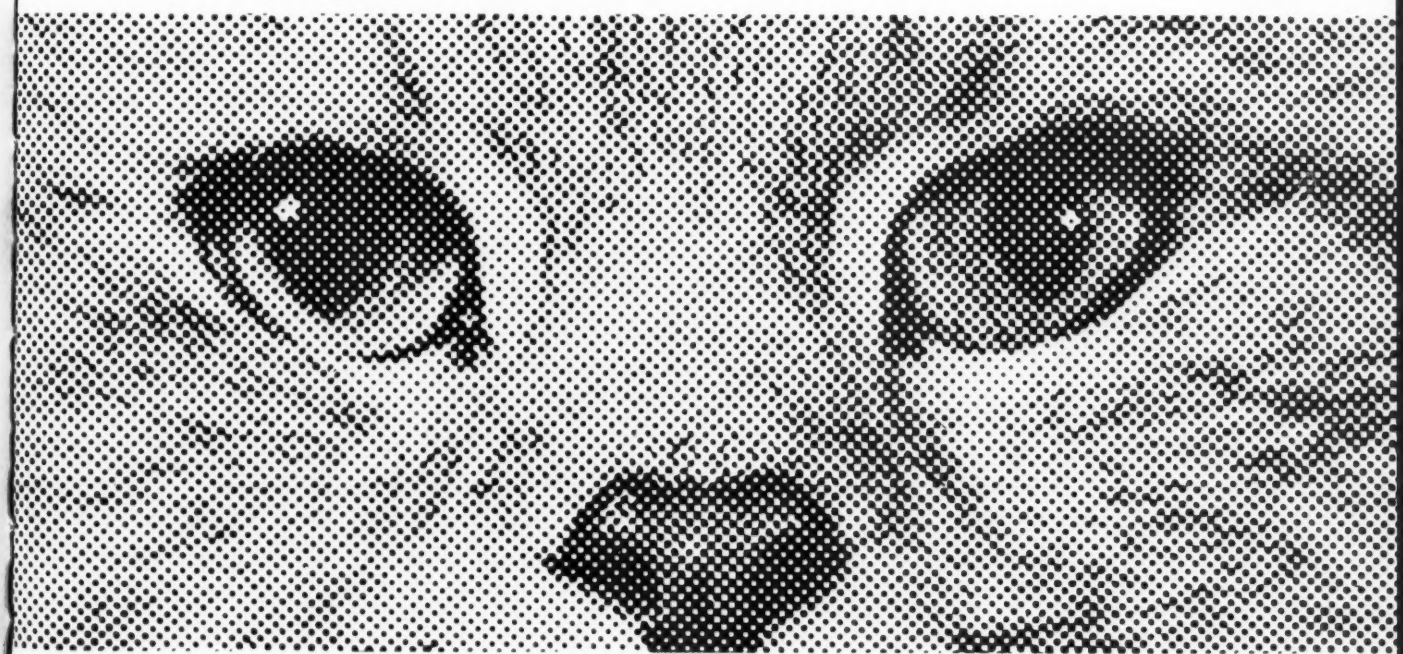
But it is the wrong thing to do at night, because then you look at the object with the blind spot (cones) in the center of of your eyes. Take advantage of the rods and look slightly away from the object for maximum sensitivity.

If you see an object on the ground and lose it, don't try to bore through the darkness to find it again. Instead, look slightly above, below, or to one side with a roving or scanning gaze. This requires practice, but it works.

In daytime, you see the color and detail of an object as well as the size and the contrast it makes against the background. Your night eyes see no color nor detail. You depend entirely on the object's size and contrast to see it. This means that familiar things look quite different at night from the way they look in the daylight. Since you have not had as much practice in night seeing as in day seeing, objects are harder to identify.

Your eyes furnish so little information at night that you must be able to interpret the smallest clues in order to see the objects your eyes pick out. A tiny spot of exhaust flame tells you that motor vehicles are below. A spark from a piece of metal hitting a rock might indicate that some trooper let the end of his rifle hit a rock.

Learn more about night vision, practice it, and you'll be able to see like a tomcat in the dark.



DO - IT-YOURSELF SURVIVAL KITS

Captain William F. Flynn

It is a universally accepted truism that the average Army Aviator is an intelligent, dedicated individual, with the resourcefulness of a Plains Indian and the wit and cunning of a diamond smuggler.

He flies low and slow over every kind of horrendous terrain this green earth has to offer, and does so with remarkable skill and safety. Occasionally, however, his aircraft fails him (or vice versa, or both) and he finds himself in Boondocksville with a Jep case, half a candy bar, three matches, one stale cigar, and a disgraced rabbit's foot. As likely as not, he will also have half a dozen passengers—in mild shock or high dudgeon, depending on rank.

These last will turn trusting, beseeching eyes on the hapless aviator, with childlike trust in his ability to lead them safely out of the wilderness. Now said intrepid aviator calls on all his resourcefulness as, mind racing, he prepares an explanation for the fact that, since the area is neither glacial nor equatorial, their survival gear consists solely of one Jep case, half a candy bar, etc., etc. . . .

WE WERE SITTING in the pilot's ready room one fine zero-zero day in France discussing just this situation. Take an Army Aviator, one each, fearless. Enclose him in a fireproofed flight suit, with boots and gloves. Encase his valuable

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Capt Flynn is the flight surgeon, 319th Station Hospital, APO 122, N.Y., N.Y.

gray matter in a snug-fitting helmet which will protect him from anything but a lightning strike. Seat-belt him and shoulder-harness him into an aircraft which can land in horrible terrain and still stay in one relatively large chunk.

Voila! Friend Aviator blows a jug over Heaven-Knows-Where, sets his sturdy craft down on an abandoned squirrel trail, and steps from the relatively large chunk containing the cockpit—to find himself far, far up the proverbial creek without even a semblance of a paddle. While on short final he has done a masterful job of camouflaging his aircraft (it is festooned with bits and pieces of trees, shrubs, bird nests, and the like). It is now wrapped neatly about the base of an umbrella-like tree which effectively shields it from all eyes, friend and foe. As an encore, he has wrenched one knee. His ankle is turning an alarming shade of purple and is triple its usual size.

"What we need," quoth I, nodding sagely (as one learns to do when on unsure ground), "is a handy-dandy, all purpose, temperate zone survival kit, something to tide us over until they become an item of issue."

"That's a great idea, friendly flight surgeon," chorused my sturdy charges. "Why don't you go ahead and whip one up?"

Thirty-seven reasons-why-not later, they convinced me that, as the only person having access to bandaids and snakebite kits, I was the logical choice to manufacture this concentrated RONONON kit. Undaunted by this and other specious reasons, I accepted as a matter of honor (i.e., my foot was still stuck firmly on an eyetooth), and opened the floor to suggestions.

Though the Pentagon may not yet have been apprised of the fact, a group of renegade Army Aviators, grounded by weather and prodded onto a topic of conversation other than Miss July or imminent checkrides—in short, an Army Aviator's brainstorming session—is The Ultimate Weapon. Suggestions flew about. Improvements were improved upon endlessly, until we were faced with a veritable welter of some five hundred and seven suggestions. Since this number seemed rather unwieldy, we determined to reduce it to one more easily manageable by eliminating the ribald

TABLE I

AIRCRAFT SURVIVAL KIT, LARGE

Medical items:
- a. Airway, plastic (for rescue breathing) 1
- b. Instructions for use of airway 1
- c. Plastic bag for airway 1
- d. Extra large field dressing 1
- e. Large field dressing 2
- f. Small field dressing 4
- g. Compressed gauze bandage 2
- h. Roller gauze, 3 inches 2
- i. 4" x 4" gauze pads 10
- j. Vaseline gauze packages 2
- k. Adhesive tape, one inch wide, roll 1
- l. Elastic bandage, 2 inches wide 1
- m. Eye injury treatment kit 1
- n. Burn mixture (powder to be mixed with water & drunk by burn victim), envelopes 3
- o. Bandaids 15
- p. Surgical suture with needle attached 1
- q. Antiseptic solution, 10cc 1
- r. Anti-fungal ointment 1
- s. Anti-sunburn ointment .. 1
- t. Poison Ivy ointment 1
- u. Calamine lotion, 2 ounces, bottle 1
- v. Surgical soap, bar 1
- w. Tablets: (1) Vitamins, vial 1
  (2) Aspirin, vial 1
  (3) Antibiotic, vial 1
- x. Tourniquet, web 1
- y. Antibiotic ointment 2
- z. First aid instructions 1

Rations:
- a. Ration tins, containing:
  (1) Jelly bars (250 calories each) 8
  (2) Powdered tea, packets 3
  (3) Powdered coffee, packets 3
  (4) Chewing gum, sticks 3
  (5) Sugar cubes (25 calories each) 5
  (6) Vitamin pills 3
  (7) Water purification tablets, bottle 1
  (8) Survival instructions 1
- b. Meat food product bars, 3 oz each 3
- c. Supplemental beverages and sundries:
  (1) Powdered tea, packets 3
  (2) Sugar, packets 5
  (3) Powdered coffee, packets 15
  (4) Dry cream product.... 6
  (5) Candy bar 1
  (6) Chewing gum, small pack 1
  (7) Salt, packets 3
  (8) Powdered soup 3
- d. Spoons, plastic 4

Miscellaneous survival gear:
- a. GI can opener 1
- b. Waterproof matches, books 8
- c. Light string, 10 feet 1
- d. Cord, 10 feet 1
- e. Toilet paper (c-ration type) roll 2
- f. ICAO panel and hand signal sheet 1
- g. Rubber tubing, 2 feet 1
- h. Nylon parachute cord, 15 feet 1
- i. Fish hooks 2
- j. Needle with 5 feet of thread 1
- k. Plastic bag 8 x 10 inches 1
- l. Survival knife with 6 inch blade 1
- m. Utility cans, round, with lid 2
- n. Snare wire, 5 feet 1
- o. Safety pins 12
- p. Candles, 4 inch length.... 2
- q. Extra water purification tablets, bottle 1
- r. Signal mirrors (tops and bottoms of ration tins).... 4

ones thus allowing me to plunge into the project with those suggestions remaining.

Armed with these, I sallied forth to do battle with the grim specter which confronted our fearless aviator a few paragraphs back. Rather than risk the gentle reader's exposure to the nerve-shattering experiences of early beggarhood, I will omit the sordid details of the ensuing few months.

Suffice it to say that upon entering the dark, devious world of the Scrounge, one must cast aside all pretense of morality. One must plumb the depths, regard no guileful trick, no evil stratagem, no hint of threat or blackmail as *too low*. I will not dwell upon the crafty, camel-trader smiles, the Faustian pacts, the skrieks, groanings and tooth-gnashings of supply personnel, lest the reader blanch with despair. Rather, I will present the reader with some mundane tokens, viz., a table of contents (table 1, naturally).

This kit has been installed in all U-1As, CH-34s and U-6s within our bailiwick. It is packed in a salvaged .50 caliber ammunition can. A smaller, cut-down version has been packed in a .30 caliber ammo can and distributed for use in OH-13s, U-8s, and O-1s. (These are the only aircraft assigned to our area.) The kits are made the responsibility of the crewchief when applicable, and are assigned a priority slightly above his coffee thermos, in case of acident.

Well, everything was jake for a while, until one day an intrepid aviator stood up and said: "You know, Doc, I've been thinking. . . ." This was instantaneously attended by a standing ovation from all present, as it was 1645 on a Friday afternoon. "No, no," he persisted (Army Aviators are as tenacious as moray eels). "I mean suppose the ship burns and you get out with just the clothes on your back? What then, O staunch comrades-in-arms?"

What else, but to have a small compact escape kit secreted somewhere in one's clothing, a la Houdini? Only two criteria were necessary: it had to be as small and inconspicuous as James Bond's Beretta (without the silencer) and as chock-full of goodies as a Sears catalog. No problem, really.

Once more, gentle reader, into the murky world of the beggar-for-hire, the furtive flittings from door to door, the midnight deliveries of odd-shaped packages hurled from speeding sedans with mud on the license plates. . . .

In due course (which means it took five times as long as expected, the Son of Survive-all Kit was born and its innards are listed (in no logical fashion at all) in table 2.

This little kit has none of the spice and dash of its ancestor, in that much of it was bought outright in an unspectacular, deplorably honest manner. Nonetheless, it is something to snuggle up to on a cold night in the Boonies (not much, but something). Your friendly flight surgeon was a sometime boy scout

TABLE II

INDIVIDUAL SURVIVAL KIT

1. Medical items:	
(a) Burn mixture (powder to be mixed with water & drunk by burn victims)	2 env
(b) Gauze dressing, 6 yards	1 packet
(c) Bandaids	5
(d) Eye patch, sterile	1
(e) Adhesive tape, ¼" wide	2 feet
(f) Antiseptic solution, 2cc	1 vial
(g) Scalpel blade	1
(h) Finger splint, wood	1
(i) Tablets (with instructions for use)	
(1) Tetracycline (antibiotic)	6
(2) Vitamins, multiple	6
(3) Aspirin	6
(4) Antidiarrheal	2
(5) Salt tablets	6
2. Rations:	
a. Sugar packets (100 calories)	4
b. Dry cream (110 calories)	3
c. Coffee, powdered	5
d. Soup, powdered (150 calories)	1
e. Candy bar, jelly (250 calories)	1
f. Chewing gum (chiclets)	2
g. Game seasonings (chili, salt, onion powder)	3
3. Miscellaneous survival gear:	
a. GI can opener	1
b. Nails, 2½ inch	5
c. Snare wire	10 feet
d. Cord, medium	6 feet
e. Cord, light	6 feet
f. Safety pins	5
g. Flare gun (with a ball pen)	1
h. Flare gun adaptor	1
i. Firing caps, .22 cal	10
j. Flares (yellow, green, red, white)	5
k. Needle with 5 feet of thread	1
l. Fish hooks with leader	2
m. Water purification tablets	5
n. Aluminum foil	2 sq ft
o. Plastic bag (used to seal kit)	1
p. Instruction sheet	1

(with merit badges in basket weaving, astronomy, and malingering) and is consequently far from being an expert in the field; so the perceptive reader will notice some glaring omissions. So be it. The kit's size (5½" x 4¼" x 1¼") dictated that some items be sacrificed (we had to scrap the trench mortar and the frozen daiquiri). As it is, the kits were closed with the indispensable aid of an overweight pilot (it is well to keep at least one around at all times) and should be opened wearing a catcher's mask, lest some needed item fly up and imbed itself in the user's skull and hence be lost.

A word about the kit container itself: it is aluminum, lightweight, and can be used as a signal mirror or as a cooking vessel for brewing up a homey mess of rattlesnake goulash. The aluminum tape used to seal it makes a tolerable pair of snow

goggles and can also be used for signaling. The miniature flare-gun will shoot multicolored flares to a height of about 200 feet and is, of course, useful for night signaling or for letting one's distress be known from beneath a thick cover of banyan trees.

Starting with this all-climate type kit, other small pocket-sized affairs could be fabricated to supplement it in certain areas (e.g., add a snakebite kit for jungle operations, a fat, warm female Eskimo for the Arctic, etc.). The possibilities are endless, relatively cheap, and limited only by one's imagination.

As noted before, this particular little offering is certainly not the last word in individual survival kits. However, this writer would chuckle with delight if some enterprising young researcher would seize on it, perfect it, marry a comptroller's daughter, and have a kit like it placed (as an item of standard issue, dammit!) in the pocket of every Army Aviator's flight suit.

For availability date of survival kits see "Letters," DIGEST Nov. '63.—Editor.

WINTER WISDOM

CHOOSE YOUR engine runup spot with care.

Last year an airplane almost came to grief because of the spot its crew chose for runup. It was snowing and the aircraft, already checked and found free of snow, was taxied out for runup. There was a four engine transport ahead of it, and an appreciable delay in getting an ATC clearance. Just prior to rolling, the copilot checked the wings again for snow. There was none. On the takeoff, however, the aircraft's left wing dropped abruptly and the pilot had to climb considerably faster than normal and with a goodly amount of right aileron in order to keep the wing up. Investigation indicated the underside of the left wing was covered with snow which had been blown back by the transport holding ahead of it.

For safety's sake, don't taxi or park close behind another aircraft when it is snowing or when there is snow on the ground. Before takeoff, carefully inspect the wings, top and bottom. Remember that frost and snow can be killers, and even that thin layer of frost that can barely be seen can buy the farm for you. Don't pooh-pooh it and think it will blow off. It might not.

—Flight Safety Foundation

This Could Be Yours

Major Richard J. Scheafnocker

THIS WAS ONE of those typical sunny California days—not a cloud in the sky, wind from the west at 10, gusts to 25, temperature 100 degrees. The aviation section had just settled down for the daily "hangar flying" session. Lieutenant Jones was relating his flying experience in the U-6A.

"Listen," he said, "that Beaver is a real airplane." He went on to tell the story of his flights to battalion with personnel and equipment, of the gusty winds he had encountered near that ridge south of the strip, and how many times he had "filled it to the brim" and it flew like a dream.

Just then the telephone rang. Lieutenant Jones answered the phone. "Flight Operations. Lieutenant Jones speaking, sir!" he said.

"Jones," the voice said, "this is Colonel White. We have some equipment to go to battalion. It's rather heavy and bulky. Can you take it?"

"If it will fit in the plane, we can take it," Jones replied.

"Fine," said Colonel White, "I'll send it right out."

A Master Army Aviator, Maj Scheafnocker is Chief, Research and Analysis Branch, Dept of Tactics, USAAVNS, Ft Rucker.

That's the way a typical sunny California day started. The equipment arrived in a 6 x 6 and was loaded aboard the Beaver. It all "fit," so no one bothered to check the weight. Jones' takeoff was normal. The crew watched the aircraft leave the ground, make a climbing turn to the right, bouncing in the gusty wind, and then go out of control and crash. LOST: 1 pilot, 1 U-6A, and a cargo of expensive equipment. Investigation revealed the cause of the accident to be structural failure.

* * *

This is not a true story but then neither is it fantasy. This could happen, and it could happen to you. What caused the failure?

Aircraft are not just "built." They are designed. Basically the designer must know the mission the aircraft will be required to perform, how fast it must fly, and the maximum weight it must normally carry. From this information he can begin his design. He knows that to be effective, the aircraft must be as light as possible, it must be rigid, and its structural materials must be capable of withstanding certain maximum stresses normal to its particular mission. Three general strength requirements are common to all aircraft. An understanding of these areas will aid us in getting the most out of our aircraft.

STATIC STRENGTH

The static strength requirement is the consideration given to the effect of a one-time, slow application of load with no repetition or cyclic variations of load. An important point in this requirement is the *limit load* condition. This is the term given to the maximum of normally anticipated loads for the mission requirement of the airplane, and the structure must withstand this load with no ill effects. If the aircraft is subjected to a load greater than the limit load, permanent deformation of the structure will be incurred which requires replacement of the damaged parts. To provide for rare instances when a load greater than the limit is required in an emergency, a safety factor 1.5 times the limit load is provided.

To summarize, the aircraft is capable of withstanding a certain maximum load for the designed life of the aircraft. It is also capable of withstanding for a one-time emergency 1.5 times the maximum load without failure to its major load carrying components. We must remember that any time we exceed the maximum limit load, we can expect deformation of some part of the structure, and if we ex-

ceed the ultimate factor we can expect structural failure.

FATIGUE STRENGTH

The fatigue strength requirement is the consideration given the cumulative effect of repeated (cyclic) loads during service. If a repeated tension load is applied to metal, the part is subject to a "fatigue" type loading. After a period of time, we can expect the material to crack and finally rupture. How long it takes to rupture depends on the magnitude of the cyclic load. A high stress requires very few cycles to produce failure, while a very low stress may require an infinite number of cycles to produce failure.

For each type of aircraft, various loads will be encountered with a cyclic frequency particular to the mission. The primary structure is required to sustain the typical load spectrum throughout service life without fatigue failure. If we subject the aircraft to load spectrums greater than was considered in design, failures can occur before the end of the service life.

AEROELASTIC PROBLEMS

The third requirement concerns aeroelastic problems encountered due to the interaction of aerodynamic forces and elastic deflections of the structure. The aircraft must have sufficient stiffness to minimize aeroelastic influences in the normal flight range. It is important to know the difference between strength and stiffness. Strength is the resistance to load, while stiffness is the resistance to deformation. The problems involved are specific to the qualities of the structure and the dynamic pressure of flight. Therefore, specific operating limitations imposed will be in relation to a certain airspeed.

These are the three basic considerations in aircraft design. Each part of the aircraft has been studied. When it is delivered to you, it is ready to perform the mission for which it was designed. The manufacturer has gone to great lengths to provide a safe aircraft, provided it is flown properly. He knows its limitations and has given this information to you in your -10 flight handbook.

The flight operating strength of the aircraft is presented on the Operating Flight Limits Chart on which horizontal scale is airspeed (V) and vertical scale is load factor (g). The graph is contingent on 3 factors being known: gross weight, configuration, and symmetry of loading. Its boundary lines show airspeeds and load factors which must not be exceeded under any circumstances. The flight loads are conveniently expressed as multiples of the gross weight. The number by which the gross weight is multiplied to derive the flight load is known as the load factor. The boundary lines represent the limit load factors, for the gross weight resulting from maneuvers initiated by the pilot.

Flight loads of considerable magnitude may also result from atmospheric gusts. Aircraft are designed to withstand 30 fps gusts at maximum permissible airspeed. Procedures outlined in the handbook under the heading "Flight in Turbulence and Thunderstorms" should be followed.

Being aware of the flight limitations will enable you to get the most from your aircraft. Had Lieutenant Jones kept a record of the times he had overstressed the aircraft, inspections would have revealed the obvious early fatigue and the accident would have been avoided.

Flying is enjoyable and we are provided with excellent aircraft. They are, however, designed for a certain mission and should be flown accordingly. The operation of any aircraft is subject to specific operating strength limitations. A single large overstress may cause structural failure or damage severe enough to require costly overhaul. Less severe overstress repeated for sufficient time will cause fatigue cracking and require replacement of parts to prevent subsequent failure.

Look to the flight handbook for safe flying. Remember, Lieutenant Jones' accident could be yours.

This graphic picture shows what can happen when an aircraft is operated beyond its design limitations

A (Safe) Christmas Flight

LET'S SEE. Bring us some Chawan-musi as a soup course. Then we'll have Shrimp Foo Yung, Formosan Pork, Pregnant Cucumber, Kame-nan-ban, and of course, rice. Make everything for two. Bring me chopsticks, but a fork for my friend."

"I hope you know what you ordered," said Lieutenant Gibbs.

"Well almost," the captain answered. "That's what I had last time I was here. It tasted good. But I don't know what's in the Chawan-musi, and I'm afraid to ask."

Captain Buck and Lieutenant Gibbs were sitting in the famous Tai Pak boat restaurant of Hong Kong, waiting to eat a delicious Chinese lunch. It was Christmas Eve.

As they waited for their meal to be served the two fell silent, watching the scene before them. Through the window they could see the floating homes of the Tanka people—Chinese who live their whole lives on boats. Many years ago the law forbade them to go ashore. Now they can do as they please, but many prefer to live in boats rather than on land.

Last Friday Captain Buck had been called into his CO's office in Taiwan. It was Captain Buck's turn to fly courier service to Hong Kong, and the colonel wanted him to get a load of toys while there. The enlisted men of the outfit had decided to give a Christmas party for the Taiwanese children living near the little airfield. Each man was to adopt two Chinese children for the occasion and give each a toy at the party. Unfortunately, by the time the men had things organized, most of the toys were gone from the PX shelves. So the colonel asked Captain Buck to buy the toys while in Hong Kong.

But as luck would have it, numerous thunderstorms in the area prevented their getting off the ground on Saturday. The next day, of course, was Sunday, so this left only one day to get to Hong Kong, complete the mission, buy the toys, and get back for the party on Christmas Eve night.

As they came in over the bay this morning before they set down on the long runway extending out from Kowloon (or the "New Territories"), Captain Buck and Lieutenant Gibbs could see the vast concrete apartment houses built for the millions of Chinese refugees. On the waters of the bay were thousands of ships of every size, and crowded along the shore were the floating homes of the boat people that they were now seeing from the restaurant window.

Taking a taxi from Kai Tak airport they had decided to go to Nathan Road, which was Hong Kong's shopping center. As the taxi wove its way through the crowded streets they were treated to a view of the many faces of Hong Kong. Doubledecker buses gave it a look of London (with a Chinese accent). Night clubs calling themselves the "New Yorker" or the "Manhattan" gave the place an air of the new world.

Even one restaurant decked out in New Orleans iron lace called itself "Antoine of the Far East."

Old style food shops, with dried, almost transparent, ducks hanging from the ceiling, mountains of eggs sorted according to age, and crocks of pickled cabbage, competed for the Hong Kong dollar with modern supermarkets full of American style canned food.

Wood shops selling crudely made stools, chairs, and tubs competed with modern looking furniture stores selling expensive and well made rice chests and altar tables (sold to Americans as sewing tables so as not to offend the gods).

And people were everywhere. The streets were so crowded that it appeared the taxi ran the risk of being overrun by them.

In spite of the crowded streets, they reached Nathan Road in only a few minutes. Here could be found everything the heart desired—from Parisian perfumes to Swiss watches, antique perfume to German cameras, fortune tellers to tatto artists—all at bargain prices.

Ignoring the traffic that piled up around him, the taxi driver stopped long enough to ask, "What you wish to buy?"

"Toys," the captain said.

"Daimarus" the driver answered and started his taxi with a neck snapping jerk.

In the next block he stopped at a modern glass-faced department store. Inside, the two officers found that the taxi driver had been right. The shelves were piled high with toys.

A beautiful Chinese girl, wearing a slit dress that revealed much of her shapely legs, asked if she could be of help. Captain Buck handed her a shopping list and asked if she could fill it.

"Yes, sir. We can. When should the toys be ready?"

"Well, I'm flying back to Taiwan this afternoon. Could they be ready by two o'clock?"

"Yes, sir. Shall I have them packed and delivered to the airport?"

"Yes, thank you."

The captain gave her his name and the location of his airplane.

Thus there was nothing to do but roam around Hong Kong until time to start back.

Captain Buck and Lieutenant Gibbs spent part of the time window shopping—first on the Kowloon side and then, taking the Star ferry across the bay to Hong Kong Island, the commercial hub, with its banks, insurance companies, shipping firms and exclusive shops. Finally they took a sampan to the Tai Pak restaurant.

When they finished eating they went back to the airport to get ready for the return trip. The toys arrived, and satisfied that they were as ordered the two officers loaded them on board.

Everything seemed all set for a smooth ride back to Taiwan—until Captain Buck checked the weather. He received a jolt. When they had left early in the morning a cold front was moving in, but it was not due until sometime later Christmas Day.

But the weatherman at Hong Kong said, "There's a cold front north of Taiwan and unstable air moving up from the south. Your destination is in a severe WX area."

"Are you sure?"

"Yes, sir. Moved in fast."

"Good gravy; it sure must have!"

Lieutenant Gibbs looked at the captain. The expression on his face asked a question, "Do we go or stay?"

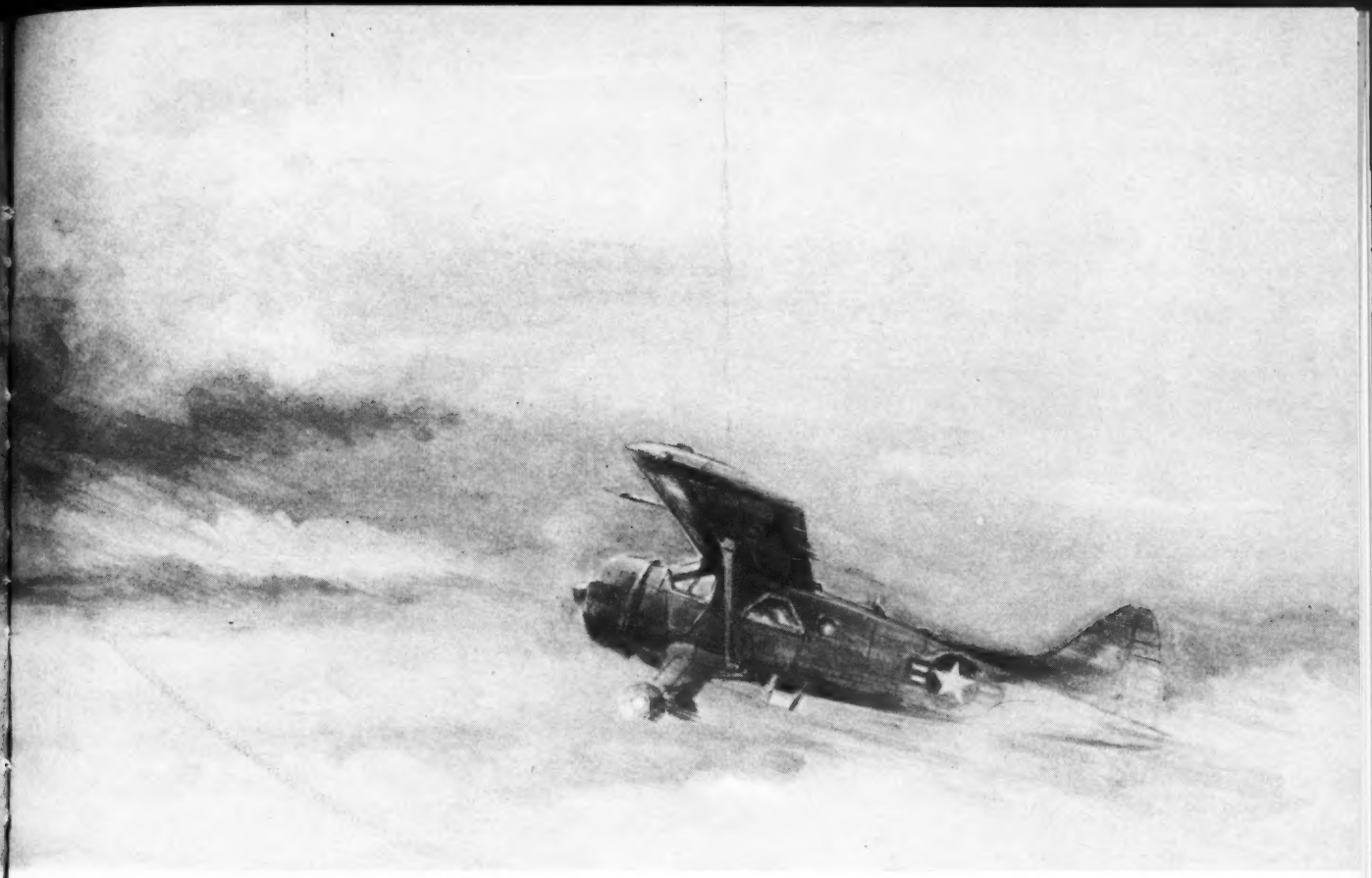
"All those toys," Captain Buck said, almost to himself. "What rotten luck. Lot of disappointed kids. And my own kids . . . Come on, Gibbs. If it's moving so fast, maybe it will clear by the time we get there."

They took off VFR and flew first due east to clear the coast of Communist China and then north to reach the southernmost tip of Taiwan. About 30 miles out, an overcast began to appear. The captain refiled for IFR.

Soon the front was quite heavy and turbulent. Captain Buck requested a climb to VFR on top. At about 10,000 feet they broke through only to see a buildup in front of them much too high to clear. Lieutenant Gibbs instinctively tightened his harness.

Captain Buck put both hands on the stick as though he were going through. Instead, he slowly turned the airplane around and headed back to Hong Kong.

"Sorry, Gibbs," he said, as if to justify his actions. "I'd like to deliver the toys, but this bird was not built for that kind of muck."



"The very thing I was thinking, Captain."

On Christmas morning they rose very early and headed home. The weather was clear and the trip was uneventful. At their home field Captain Buck put the bird down lightly, even though he had a heavy heart.

The soldier who met the plane saluted Captain Buck and told him that the CO wanted to see him right away. On the way to the office, Captain Buck could not help wondering what the colonel was doing in his office on Christmas morning and what he wanted. No doubt it had something to do with his not delivering the toys on time.

As he entered the colonel's office, Captain Buck saluted and said, "Sorry, Colonel. I tried to get through, but the weather was too bad."

"Captain, it's a good thing you didn't."

"What do you mean?"

"Take a look out the back window."

Captain Buck went to the window, and what he saw gave him a jolt. A pile of smoltering charcoal and burnt timbers was all that remained of the old barracks building that was to have been used for the children's party.

Turning back to the Colonel he asked. "What happened?"

"About seven last night we thought you still might make it back. So Sergeant Mac built a fire in the old pot-bellied stove to get rid of the chill in the building. About eight we realized that you wouldn't get through, so we called the whole thing off. A little later the old building burst into flames. We think the chimney leaked sparks into the attic."

"That's too bad," Captain Buck said.

"Could have been worse, much worse. Think what could have happened. In less than 5 minutes that whole building was in flames and had burned to the ground. What would have happened if we had had the party? Not many of those children would be alive today."

The colonel paused for a minute. Then he said, "Captain, something kept you from delivering those toys, and thank goodness it did."

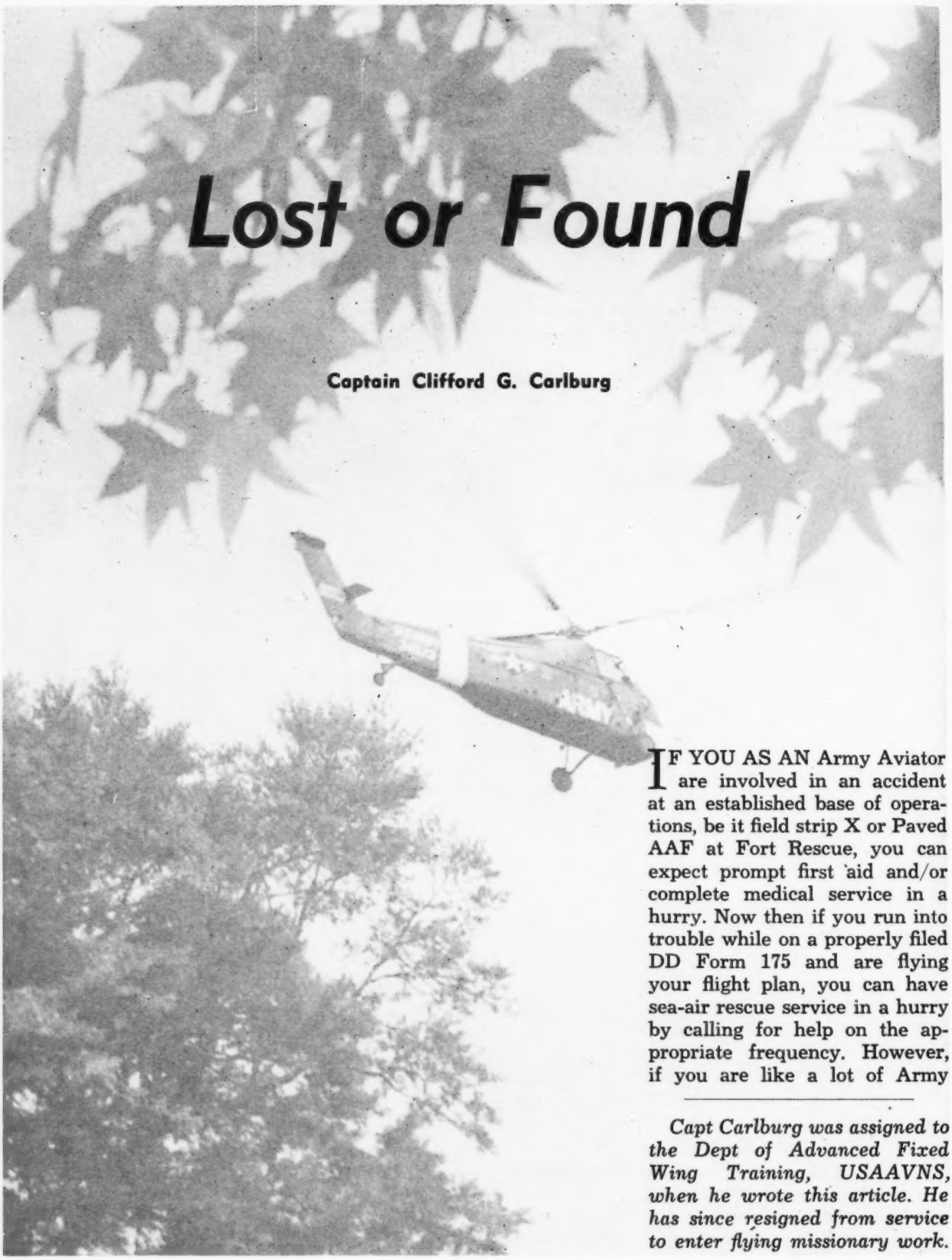
For a moment both of them were silent, thinking about the fire, the children, and the weather that kept the airplane in Hong Kong.

Then Captain Buck remembered the toys. He asked the colonel what to do with them.

"Oh! We're going to have the party after all. It'll be in the mess hall at ten this morning. Everything's ready to go. I brought my Christmas tree over; my kids are big now and won't miss it much. Folks started bringing in decorations real early this morning, and the cooks have already baked. . . ."

Lost or Found

Captain Clifford G. Carlburg



IF YOU AS AN Army Aviator are involved in an accident at an established base of operations, be it field strip X or Paved AAF at Fort Rescue, you can expect prompt first aid and/or complete medical service in a hurry. Now then if you run into trouble while on a properly filed DD Form 175 and are flying your flight plan, you can have sea-air rescue service in a hurry by calling for help on the appropriate frequency. However, if you are like a lot of Army

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Capt Carlburg was assigned to the Dept of Advanced Fixed Wing Training, USAAVNS, when he wrote this article. He has since resigned from service to enter flying missionary work.

Aviators, many of your missions will be filed on local flight plan DD 1080, and this covers a 100-mile radius local area. This can be a big area to search if you should run into trouble, and it may take longer to get help.

It seems to me that the hardest place to find a downed aircraft would be in this local flying area. The main problem is the extensive area involved, and a contributing factor is the way most aviators file local flight plans. A common way is to put ETE as max fuel range minus a 30-minute reserve, with only one intended base of landing. If this is the only information on the flight plan, it could be a long time before anyone is aware of your difficulty or know where to look if you are overdue. The DD 1080 should be filled out as completely and carefully as the DD 175. Periodic position reports should be made to home base or some other appropriate facility. This is just good planning.

Now let's discuss the various members of the crash-rescue drama as they operate in the elsewhere area. First, let's consider the pilot who suddenly finds gravity as his only motivating force. He has his hands full just hanging onto his own physical functions and aircraft, but if he can put out even a frightened call for help and has filed a good flight plan, help can be on the way in a hurry. If he can add a position report his odds improve even more. Once on the ground he can do various things to increase his own visibility to aid searchers.

Next, let's consider the tower operator. He probably will be the one to set the search in motion. It is imperative then that he know what he can do to aid the search. The most important point for him will be to record exactly the position report or to keep track of the aircraft if it is in sight at the time the emergency occurs. Every Army tower that I have visited has a crash map available for instant reference. This has various landmarks and course lines and distances marked by concentric circles. Once the tower operator has plotted the location on his crash map, he can then direct aircraft in their search for the wreck.

Let's talk about this map a little more in connection with the search aviator. The map is of little value to a search pilot if the only copy is in the tower. Therefore a crash map should be available to each aviator, either personally or in each aircraft at a particular field. Also each aviator should be scheduled training missions where he is required to find a grid square location on the ground and report back everything located in the square. This will aid him in making his search for a downed aircraft or pilot. Too much time can be lost in searching an area when the search team should move on. Aviators should be trained in the best techniques for searching the greatest area possible in shortest amount of time.

Once an aviator locates the crash, he then may be able to land close by if in a helicopter or he may report the location and then direct a ground party to the scene. Do you know the aircraft signals to use in directing a ground party without radio contact? Maybe a quick review of FM 1-100 might help. Also the local SSI or SOI might help here.

Now that we have the ground party into our discussion, what can they do to expedite getting to the scene. At the time of the alert, they should assemble at a preselected area to await detailed directions to the area or direction of the crash.

Now let's go through a situation based on fact and see what could have been done differently. The emergency involved was engine failure within 5 miles of Paved AAF. Tower contact had been established, and the tower operator had the aircraft in sight when the emergency occurred. The aviator thus was assured of prompt assistance and did not further amplify his position. The forced landing was accomplished without damage. It was one hour before the ground party or any aircraft arrived at the scene. And at least one CH-21 was already flying in the pattern at the airfield.

What caused the delay? First of all, the aviator could have said he was "south of the highway." This would have eliminated a large area that was searched in vain by an OH-13 for approximately 30 minutes. Also the tower operator having the aircraft in sight at the start of the forced landing could have vectored a helicopter on the back azimuth if he had noticed some landmark in the vicinity where the aircraft disappeared. The ground team lost time in rushing out to the active runway and then having to be recalled and briefed on the general area where they were to go.

During an emergency, prior planning or the lack thereof really shows up. Take a look at yourself. Would you know how to efficiently search an area without excess overlap or missing an area. What about the other members of the team—do they know their part? Have you ever practiced together so that you have confidence in each other? The old school solution still is quite obvious: prior planning prevents poor performance. It is also valid because the delay you save may be the difference between being found in time or being lost.

WHY NOT 80 ALL THE WAY?

Captain Emil R. Day

Fill out the Form "F", load 'er up, and move out at a comfortable cruise—say 80 knots.

Many of us take this approach to cargo helicopter missions and arbitrarily select a cruising airspeed which should keep vibration and fuel consumption down. 80 knots is reasonable. Or is it?

IF WE ARE in a hurry we go faster with little thought to the possibility that we may overstress the aircraft or enter a blade stall condition. It is generally known that blade stall can cause loss of control momentarily, but many of us do not consider that a severe blade stall can overstress the aircraft due to unsymmetrical loading of the rotor system and the inherent vibrations which accompany the stall.

Why not 80 knots all the way? Let's consider the CH-34 helicopter for this discussion and see why not.

A tactical mission has been assigned in which we need to fly at a gross weight of 13,300 pounds from point A to point B. En route we will have to operate at a density altitude of 3,000 feet. The weather forecaster has told us that moderate turbulence will be en-

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Capt Day was a student at the Army Aviation Safety Course, University of Southern California, when he wrote this article.

countered with a gust spread of plus or minus 15 knots.

As in most missions we want to go as fast as we can, so we normally think in these terms: How much power do I have? How fast can I cruise at high power and still have enough fuel to make it? These questions certainly must be considered. Their answers can be found in appendix 1 of the pilot's handbook, but these figures do not tell the whole story. We must also be very much concerned with the aerodynamic loads that can be applied to the helicopter by maneuvering flight, just plain turns, and wind gust or turbulence. If we say that we will cruise at 80 knots, which is available powerwise, until we approach blade stall then reduce speed a little, this is not enough, for some damage may have already been done to the aircraft. Then what airspeed should we use? For the answer let's go to the blade stall chart in section VI of the pilot's handbook.

If we consider the density altitude and weight previously mentioned and plan to use a constant 2500 rpm, blade stall will occur at 92 knots TAS or 88 knots IAS. So we decide to cruise at 80 knots IAS and feel safe in doing so. This might be true if there were no turbulence and if we did not have to make any turns during the flight.

Since the weather has been forecast for $\pm$ 15 knot gusts, let's examine what this will do to our cruising airspeed. For all practicable purposes we can add 15 knots to our 80-knot IAS cruise. The result is 95 knots, or 7 knots beyond the IAS at which blade stall would occur. The results should be obvious: excessive stress on the helicopter in addition to loss of control momentarily.

In the above case it was assumed that the pilot would have perfect rpm control at all times and only the velocity of the gust or IAS was increased. Now let's consider that for some reason the rpm was allowed to change to 2200, which is still within the operating range. From the same charts we see that at 2200 rpm, blade stall will occur at 72 knots TAS or 69 knots IAS. This is well below the 80 knots at which we decided to cruise, so again we have a blade stall condition.

Suppose that neither of the above situations occurred but that it becomes necessary to execute a 30° banked turn. By the same set of charts, we find that the helicopter will be pulling a g load of 1.15 and that there will be an IAS error of minus 5 knots. We found above that our level flight blade stall speed was 88 knots IAS. Now in the turn our airspeed indicator is short by 5 knots, so we probably would correct for the low airspeed. Then we are actually making 85 knots, which is only 3 knots below blade stall. But remember, we are in a turn and have a g load of 1.15 instead of a g load of 1.0 for level flight, so again we may encounter severe blade stall.

What have I said? Just that in too many cases we feel that if we have sufficient power to take off we can cruise at 80 and no sweat, but this is not necessarily so. All of our utility, light, and medium cargo helicopters are capable of speeds that will produce blade stall or compressibility and may, therefore, be subjected to aerodynamic loading beyond the load limit. When this occurs there is cumulative damage to the aircraft which shortens service life and/or causes fatigue failure of some critical part. Of course a margin of safety is built into the helicopter, but the pilot can induce loads aerodynamically that will exceed these safety margins. During planning, when checking the -10 for maximum gross weight for density altitude, optimum cruise speed and fuel consumption, go one step further and check blade stall charts, making allowance for gust spread and turbulence.

Just as we have learned the importance of reporting overboost, overspeed, and hard landings, we should realize the need for writing up any excessive aerodynamic loads that we may have encountered so that a thorough inspection will be made of the aircraft. If you fail to report these happenings, your best friend may be the next aviator to fly the helicopter; and, unaware of its condition, he may encounter a failure in flight which could be fatal.

A SYSTEM!

Captain Jerry R. Curry

THE DECISION was made. The months of intricate, secret planning were ended. Three totally new Army Aviation units were created. But now the most difficult phase began, the training and equipping of these units. With the global situation worsening, so little time was available.

Into the cold, impersonal computing machines an operator fed multiplex data, such as the number of officers and men in each of these new units by MOS, the different types of aircraft, anticipated missions, etc. As the machines compiled, correlated, rejected, sped on, the deadline set by the Secretary of Defense moved even closer.

The machines spewed out their digested facts on white cards punched through with various sized and shaped holes. The cards sped along a conveyer and dropped through various slots into numbered boxes. An operator checked them and carried them to other machines of the same family. A thousand miles away, in the Army Publications Center, exact replica cards slipped from the metallic boxes and sped along conveyers to many different destinations.

Having arrived, the cards triggered the release of the correct number of the particular publications they represented, and these publications sped along to packaging. A few minutes later, they were boxed and awaiting transportation to the post office for mailing. So, in a few hours, the publications necessary to operate these new military units were on the way.

* * *

Of course it was not always so. In 1963, Army Aviation units spent more time perusing their voluminous DA Pamphlet 310 series, trying to ferret out what publications were authorized, than they spent reading the publications when they arrived.

For a unit to obtain the publications needed to accomplish its mission, someone had to sit down and pick out all the applicable publications from the 310 series. This was roughly equivalent to reading a book 12 inches thick.

Even this was further complicated. The only way to tell which publications were really needed was for someone to be familiar enough with every piece of equipment in the organization to know where to look in the 310. Then, after finding the right section, he must know what to requisition in that section.

After this arduous task was completed, the requisitions were typed and sent to whatever place supplied the publications. The only way a unit could be sure it had all required publications was to find someone more familiar with the publications than unit personnel.

Higher headquarters frequently sent down a list of the mini-

Capt Curry is assigned to duty at Fort Lewis, Wash. He wrote this article while serving in Republic of Vietnam.

mum required publications, but it was never complete and often missed important publications. Furthermore, this list was often based on the experience factors of those publishing the checklist. In short, the human error factor was magnified, not reduced.

The pressing need was for a simpler way to find out exactly what publications a unit required. The method used should eliminate guesswork as much as possible. Preferably, it should be based on some constant applicable to all or nearly all similar type units.

Here you might ask what factors remain constant for all aviation units? Well, aircraft fall into this category. True they vary in type and quantity, but they are a basic end item and the crewing or flying of an O-1A will remain the same whether the aircraft is located in Germany, Korea, or the United States. So, we can safely say that maintenance publications required in most areas of the world will remain the same. Of course, Army aircraft at the South Pole will require special attention and maintenance techniques, but then the majority of Army aircraft will not be stationed in these "way out" places. It is reasonable to assume that maintenance publications required for Army aircraft are the same in most units. Distribution of these publications can well be automatic.

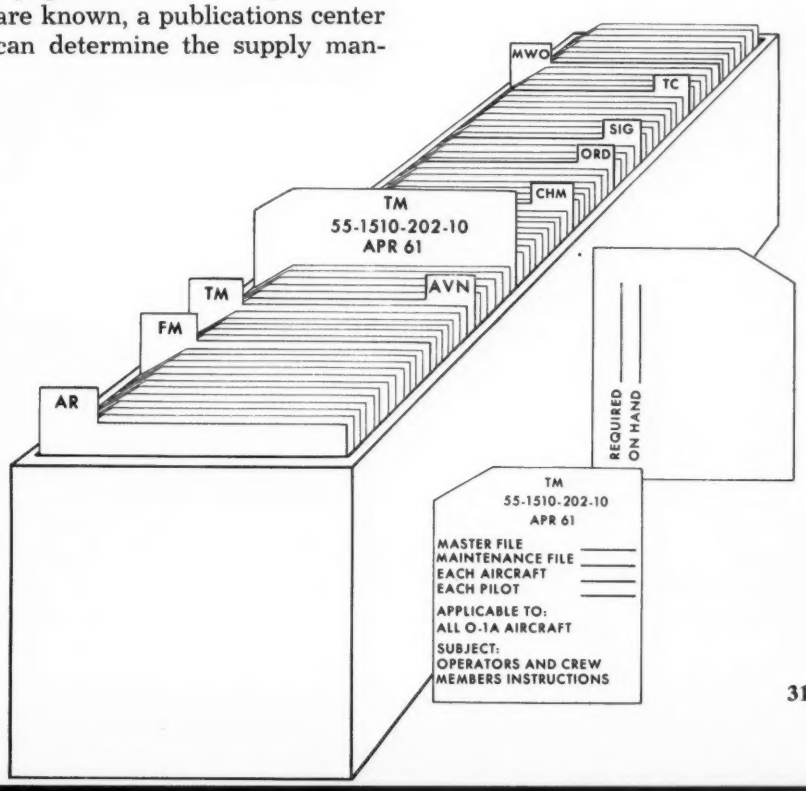
If the publications center knows the number and type aircraft assigned to a unit, it should be able to determine what aircraft maintenance publications are applicable to that unit. So, instead of each single aviation unit in the Army screening publication indexes for applicable publications, a one-time determination can be made at a central location and many man-hours saved for aviation units throughout the Army.

That takes care of aircraft, but what about all these other things like generators, night lighting sets, radios, and the old man's pot belly stove for cold nights in Yakima? Well, these items fall into the same category as aircraft. They are standard Army equipment; as such they perform the same in most areas of the world and require the same basic publications. Once the center knows the type and quantity of equipment authorized, distribution can be automatic. Any modification orders for the equipment or changes in operating instructions will be automatically distributed without waiting for a requisition. This is much the same as our present distribution of maintenance publications from St. Louis.

Let's explore some other areas. What about supply manuals? Here the same principle applies. Those manuals necessary to requisition spare parts and equipment are the same the world over. If the aircraft and equipment of an organization are known, a publications center can determine the supply manuals necessary for that equipment.

Having each unit compile its own publications requirement is like asking an aviator to sit down and list all navigational information he needs for his Jep. He will probably list all of the basic items he needs but omit many of the fringe items he never thinks of until he is looking for the frequency of Stargazer. So it is with other aspects of aviation. Most mechanics are aware that the −20 will tell them how to adjust the mixture and idle speed of a carburetor, but few will think of requisitioning a general publication on float type carburetors.

Many times people are not available who are familiar enough with the total requirement to intelligently requisition needed publications. Furthermore, people on the bottom of the pile often don't have time to screen the 310s. In my last unit the TD authorized two aircraft and one mechanic. This mechanic, and he was one of the best, didn't have time to dig out all publications applicable to his



two aircraft. He was too busy performing maintenance, parking transient aircraft, ordering spare parts, opening and closing flight plans, lighting flare pots, preparing reports, pulling CQ, etc. . . .

Well, suppose this new system does work for equipment, what about operations' publication requirements? These also fall into the same category as aircraft. The administrative publications necessary to run an operations office in France are the same as those necessary in Japan. You need flight regulations, instructions on administering the annual aviation exam, renewing instrument qualifications, preparing 759s, etc. This is well illustrated by the fact that *one* annual written exam can be prepared and administered to Army Aviators all over the world. It is assumed that the publications necessary to prepare for the exam are locally available, no matter where the unit is located.

Now let's get into the actual operation of this suggested new system. Does it work and is it really better than the 1963 system? Basically it does away with the 310 series at unit level and replaces it with a simplified card index file. This card file is made up by machine at the publications center and contains only the cards applicable to an individual unit. These cards are mailed directly to the unit concerned.

Only one card is prepared for each publication, no matter how many copies are required. Beveled on one end, these cards are grouped by type of publication —AR, SR, DA Cir, TM, etc.— and placed in a container. Index tabs are used to separate the different type publications in the container (see fig.). Containers can be produced locally to fit the requirements of each unit.

Distribution is automatic for all new publications or changes in publications. When a new or revised publication is received by a unit, a new card is enclosed with it. The old card is thrown away and the new card put in its place. This is very similar to our present Jeppesen revisions. If the publication is simply a change to an existing publication, the enclosed card also lists the number of changes that remain in effect.

At established intervals, the publications center sends the unit a list of the cards it should have in its file. The cards are then inventoried, and new or missing cards and publications are requisitioned directly from the publications center. All information necessary to requisition the publication is immediately visible on the card.

This proposed card file will occupy more space than the 310, but when we switched to Jeps we found they occupied more space than the publications we had used previously. Yet, the Jep proved itself more desirable. For a five aircraft section, the card file should occupy an area approximately 6 inches wide, 2½ inches high, and 12 inches long.

What are some of the advantages of this new system? Time, effort, and money are saved by automatic requisitioning and automatic distribution. There is no requirement for headquarters to compile minimum publication checklists. Painstaking search of the 310 series is not required. Inspections are simplified. A check of cards on hand against the inventory list of cards required against the publications themselves gives an exact picture of the status of publications in any unit at a given time. There can seldom be a valid reason for not having required publications on hand.

The most important aspect of this publications system is that the human error factor is drastically reduced. Anyone, without any knowledge of an aviation unit or its equipment, can inspect, file, or requisition the necessary publications for that unit. This has never before been possible.

Send Us Your Safety Caption

Direct communication is authorized to: Editor-in-Chief, U. S. Army Aviation Digest, Fort Rucker, Alabama.

Tales from the Trojan

"Avoid qualifying words and phrases that smother action."

"Use the simple direct approach."

"Shorter paragraphs."

"Keep your fog count low."

These are the words of Col Daniel M. Lewis (Ret) to the Communications Skills class of the Army Aviation Safety Course at the University of Southern California. And Colonel Lewis, former supervisor of Air Force flight safety publications, knows whereof he speaks.

The following eight stories were written by the members of a recent class. We really shouldn't call them *stories* because most are true accounts. The authors, understandably, prefer to remain anonymous. Each contains an important safety message.

A Change in Plans

An insistent "b'r'r'r'r!" from the field phone broke the quiet in the warm operations tent. The duty NCO took the handset from its cradle, spoke his call word, and reached for a pad of mission forms. Acknowledging the message, he rang off and sent his runner for the operations officer.

Outside, icy January air slowly warmed under a deck of clouds that occasionally released flurries of snow. It was a slow Sunday afternoon. The men of the division artillery flight were resting from extended field exercises and preparing for Army maneuvers that would start at 0400 the following morning.

We had completed a good workout in the field, relearning many things—how to warm and start aircraft before dawn in subzero temperature; how to mess, move, disperse, and secure ourselves in the numbing cold; how to fly from snow covered strips in marginal weather, both day and night. Deployed south of the Danube in Bavaria, we were ready for tomorrow.

Captain Jones came into the tent and glanced at the mission form. "They want us to take that visiting general to Vilseck at 1600. Sergeant, call the aide and tell him we want to use the CG's -19. Then find Lieutenant Stone and tell him I've got a flight for him. Better tell the aide the chopper may not get back tonight. Weather may not be too good after dark. I'll be in my tent."

"Yes Sir."

Captain Jones tramped back through the snow to his tent. He had just settled on his sack when the operations sergeant pushed his head through the flap.

"No dice, Captain. The CG wants his chopper at first light in the morning and won't release it unless you tell him it'll be back tonight. How about an OH-13 or Bird Dog?"

"A 13 couldn't make it 80 miles before dark." Jones shook his head. "Could call the aviation company for a Beaver; no sweat for an IFR flight. But we'd probably have problems getting a clearance through. Best do it ourselves in an 0-1. Shaw's a good man for this. He knows the area well, has a good instrument background, and won't take any unnecessary chances."

Shadows of darkness moved rapidly over the field at 1630. As he planned his flight, Captain Shaw mumbled to himself about the family background of generals who failed to meet schedules. "Good ship. Everything's working. Checked it out myself. Weather's not too good. Looks like these snow flurries will go on all night, but I've got 3,000-4,000 feet below the clouds. Might have to use Vilseck homer with my loop. If Vilseck gets real nasty I can always divert to Grafenwhor and get a GCA there. It's only 10 miles and the general can get a sedan back to Vilseck. If this weather holds I could be back by 1900. Gonna' have to use the flare pots for takeoff now."

He toyed with his clipboard. "First time I've drawn in a course line and made out a log card for a VFR flight in a long time. Might need it with this weather. Got the Jepp chart and the Graf letdown out too—just in case."

At 1650, the sound of a jeep moving slowly in the darkness eased Captain Shaw's mounting irritation. As he approached the jeep, he saw only the outline of the driver and the crewchief who had been guiding the vehicle. "Where's the general?"

"The aide said to tell you that he would be down in about 20 minutes. I brought his baggage —two B-4 bags and a suitcase."

"Damn! Why didn't someone tell me about this? I can't take all this junk and the general too!" snapped the captain.

As his exasperation subsided, Captain Shaw took stock of the situation. The sky above was black, but no snow had fallen for about 2 hours. He had a mission and he would get it done. "Gonna need two 0-1s and not much time left," he said. With his plans changed, he told the crewchief to get another "good Bird Dog" from the line chief and to preflight it and load it with the baggage.

As he cautiously made his way from the edge of the strip to the now inky pine stand, toward Jones' tent, he mulled over the ramifications of this unexpected development. "Weather looks better than I expected. My planning is still good. Joe Jackson is a good steady type. All he has to do is follow me. No problem."

It was mutually agreed that since the general was probably on his way by now, the mission could be continued. From the circumstances, it appeared that two 0-1s could make it safely. Lieutenant Joe Jackson was designated to fly the baggage run. A fast briefing brought Jackson up-to-date on the route, the weather, and the possibility of a diversion to the GCA equipped airfield. With that settled, Captain Shaw left to check the second aircraft while Jackson got his gear together.

Some 10 minutes had elapsed since the arrival of the baggage. As he emerged from the woods, Captain Shaw noted that the crewchief was inside his aircraft with a flashlight. As he approached, he realized the chief had just loaded the bags into his ship. "Damn it," he muttered. "Oh well, stay loose. Joe can take this one and I'll take the general in the other."

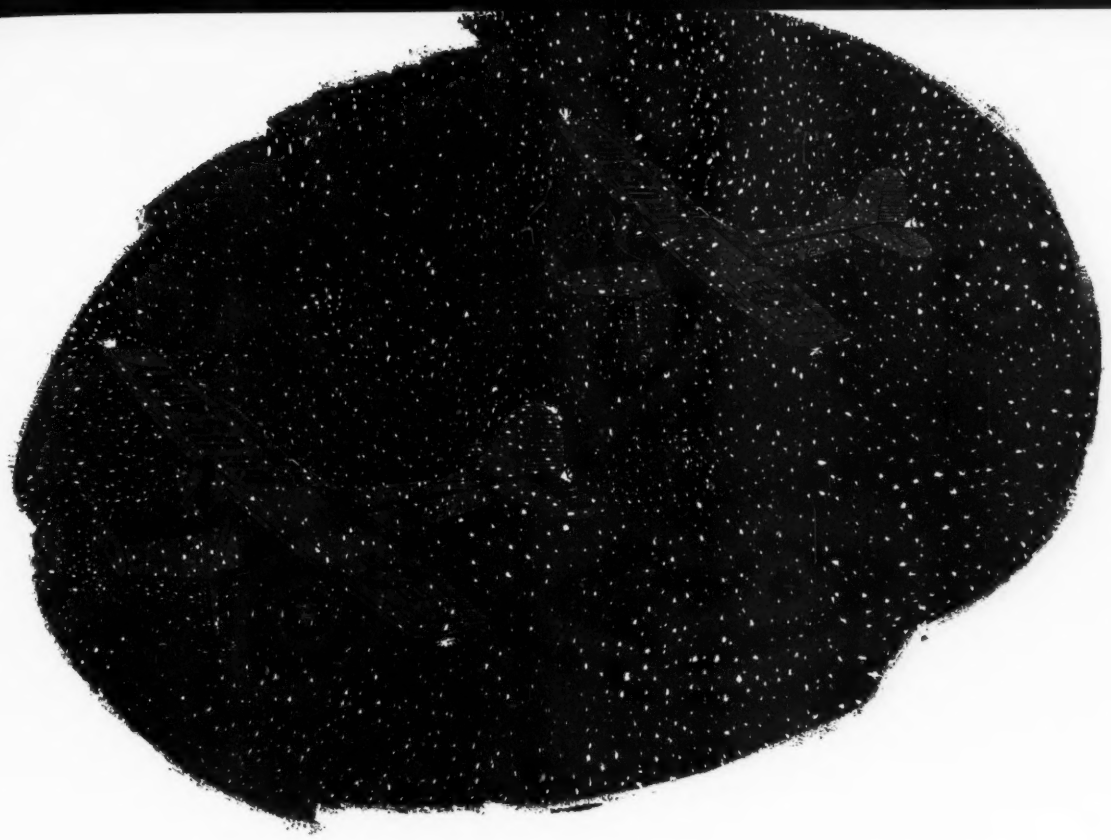
Just as he finished a close inspection of the second Bird Dog and was reaching for the maintenance forms to look at the writeups, he caught the sound of another jeep moving toward the strip. He dropped the book back into the map compartment and started toward the approaching vehicle. He saw Jackson nearing the second 0-1 and quickly advised him of the switch.

"Good evening, General." He spoke with an air of calm assurance and confidence that belied the accumulated frustrations of the preceding hour. "Everything is all set. We've got a good airplane. The weather is poor but flyable. Might have some isolated snowshowers. As soon as we fit your parachute, we'll be on our way. It should take 50 minutes to get to Vilseck."

Minutes later, aided by a ground guide, Captain Shaw carefully taxied through the snow toward the takeoff end of the runway. Jackson followed.

His runup was normal. He lined up on the strip. A mixture of oil and gas was burning in two rows of number 10 cans to outline the sides of the white runway ahead. Beyond those flickering lights, the blackness of the sky merged, undefined, with the ground. He checked his directional gyro against the strip heading. As he applied throttle, the engine responded eagerly to the influx of fuel and dense cold air.

The ground roll was short. As he climbed into the night, Captain Shaw turned his head to check Jackson's position. He could see navigation lights moving between the flare pots. As he looked rear-



ward, it became apparent that he was banked slightly to the left. He turned forward, his eyes sought the nonexistent horizon, then settled on the attitude indicator. The little red flag marked CAGED jumped out at him from the face of the instrument. "Should have uncaged that before takeoff," he reflected. As he reached for the caging knob, he again glanced to the rear to check his attitude against the now dim flare pots. Easing the wings to a level position, eyes still on the strip, he uncaged the gyro. As he turned back to that instrument, his pulse quickened. The horizon bar of the gyro quivered for a moment, then rotated and stopped in a vertical position—like a striken ship sliding beneath the waves.

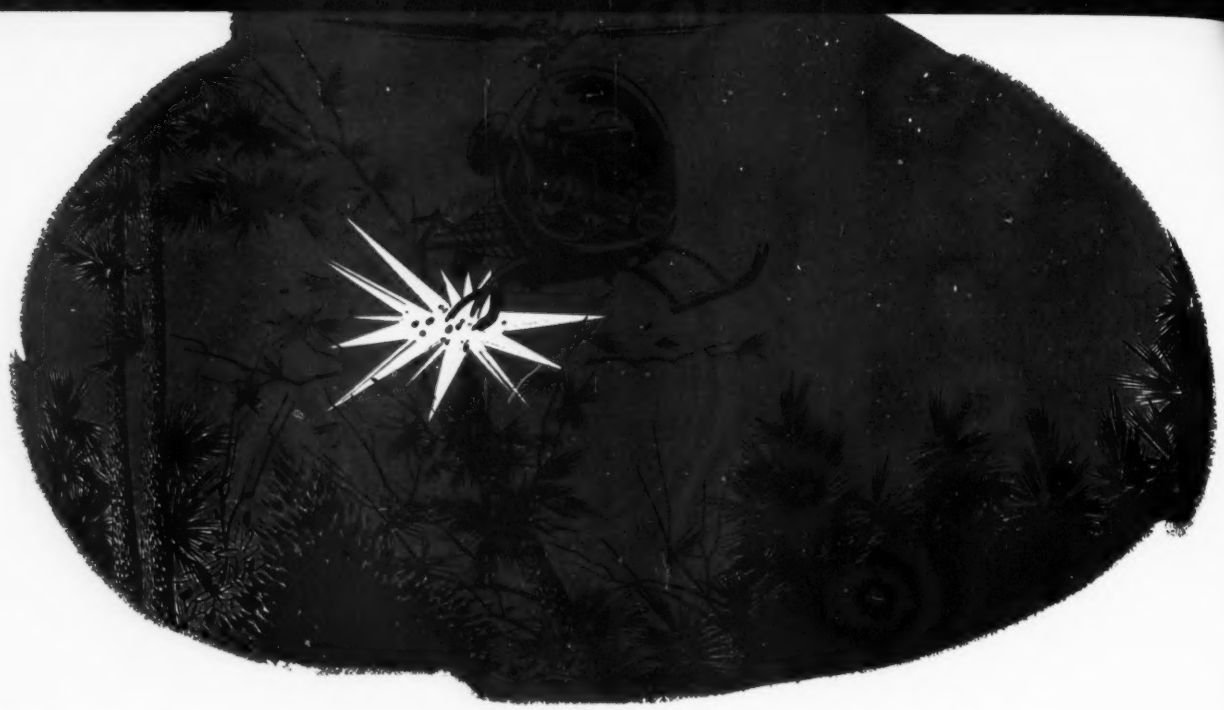
Captain Shaw shifted his attention to the turn needle. It stood firm and centered, glowing its reassurance against the dark face of the dial. The momentary apprehension caused by the inoperative attitude indicator left. He had flown needle, ball and airspeed many times.

Captain Shaw leveled off at 4,000 feet indicated. This was 2,000 feet above the ground. Ahead, he could see the orange glow of a town in the blackness of the night. It was his first checkpoint 10 miles away. "Visibility is much better than I expected," he thought to himself. Looking back, he could see Jackson now flying level to his right rear. All that was visible were the flashing red and green lights on the aircraft's wings.

As he looked at Jackson's lights, he became aware that he had dropped his left wing. Gently applying corrective stick pressure, his eyes centered on the turn needle. It indicated level flight. Uneasily, Captain Shaw made some gentle banking motions, cross-checking against the lights of the town ahead. The needle remained fixed rigidly in an upright position. He punched the circuit breakers. Nothing happened. Quickly, he took out the maintenance record that he had neglected to read earlier. There it was in black and white —two entries, a total of six words: Attitude ind. inop. and Turn needle inop. "Damn it! What was that line chief thinking about? Why didn't I read the book on the ground? Why didn't I check this while we were taxiing out?"

Shaw noticed, now with serious apprehension, that the lights of the town appeared to grow dimmer. Yet he was almost upon them. He didn't want to believe it, but a flick of his landing lights confirmed what his eyes told him: they were flying in the midst of a snowstorm. His mind raced for a solution. He didn't want to broadcast his predicament over the radio. The general had his headset on and was monitoring. He didn't want to admit the seriousness of the situation to the general. He might panic.

"Joe, this is Shaw." He spoke into the mike with forced slowness, "You take the lead. I'll navigate and give you heading information." Once past this town there would be no more visible checkpoints as long as the snow lasted. It was too



late to turn back. Except for that dim glow beneath him, and Joe's navigation lights to his rear, all else was total darkness. He would have to fly IFR formation on Jackson and rely solely on Joe's ability as an instrument pilot to get them through the snow.

Jackson rogered Shaw's instructions without question. Dropping down slightly, and straining to keep those two flashing points of reference in sight, Shaw banked to the left and turned 360° to come in close behind and to the right of Joe.

As the lights below faded from sight, he radioed a planned change of course to the lead aircraft. Shaw sweated freely as he exerted all his efforts toward keeping those two little flashing points of light in the proper perspective. If he lost visual contact, he would lose control of his aircraft. Or, if he wasn't careful, he might fly into those lights. Only one alternative now remained if he lost sight of Jackson. And how was he going to tell that big general sitting in the back that he had to bail out in a snowstorm and in the middle of nowhere? It seemed an eternity since that takeoff 15 minutes ago.

Another 15 agonizing minutes later, 50 miles short of destination, still in the snowstorm, and 5 miles left of course, they passed directly over an airfield. The field lights, though at full intensity, were visible only from directly overhead.

Once on the ground, Captain Shaw took a long time to leave his aircraft.

His mission was a failure. It could have ended in disaster. Why did it fail? How many times have YOU let the annoyance and frustration generated by a CHANGE IN PLANS compromise your preflight procedures?

The Acid Test

I could see vaguely against the dark sky the other helicopter in my team. It was about 100 feet away. I was slightly below it and this made it easier to keep my distance.

It would have been so much easier with navigation lights, but we weren't allowed to use them. Our flight was part of a test to determine the capabilities of an air cavalry troop. It was a new type of flying, with no restrictions. Several pilots had already damaged rotor blades, and I had hit the tops of several pine trees with my skids.

Midnight. It seemed much later and we'd had a long wait for the flight to begin. I glanced over to the right seat and saw my crewchief. He had never learned to read a map well enough to get across the street, and this low-level flying made it much harder. After many weeks of work with him, I'd finally resigned myself to the fact that he'd never make a navigator and had him just hold the map where I could read it. But the map wasn't doing us any good tonight. There wasn't enough light to see it, much less try to read it.

Would we be able to see one little light when we reached the road junction? Why did it have to be such a dark night? How far were we above those trees? The altimeter read 300 feet. Was it accurate? The elevation of the terrain in the area was about 125 feet and the pine trees reached up approximately 100 feet. I was about 45° to the left rear of the other OH-13. I could see the lights

on its instrument panel. Somehow that small green group of lights made me feel safer.

Suddenly, there was a sound like a shotgun blast inside the bubble. My heart went to my throat. Automatically, I reacted to pull the collective I had left and hauled back on the cyclic. We were still flying and the pine tree fell away behind us. My hands shook as I pulled in close to the lead helicopter and leveled off.

How much longer? We must be close. The entire flight was supposed to be about 20 minutes. It would take much longer to move the entire troop. We were all moving by flights of two, with 5 minutes between flights, and with no lights.

I thought I saw what looked like the road junction ahead. It wasn't. It was just more water between the trees. There was almost as much water as land in the swamps below us. What would I do if the engine quit? Would I wait until I could feel the blades hitting the trees to pull pitch? Could I slow it enough to make a vertical descent and still control it at night? The thought of going down into that blackness gave me the cold shivers.

Almost there. I could see the crossroads just ahead. As we turned right to 225°, I couldn't see the light, but I wasn't supposed to until we were about a minute out from the junction. I started dropping back to put more room between us and the lead aircraft, and that welcome light popped through the trees. It was time to slow down.

I wished I could use the landing light. I continued to slow down, a little at a time. Too high. Have to get down. Ten knots, then five. We touched down.

The crewchief jumped out and marched off, with his dim flashlight showing me the way. I followed him for about 75 yards, then set it down on his signal. I cut the engine and we tied the blade down. We heard voices in the darkness, walked toward them and found our bags. I didn't feel like pitching my pup tent. I just crawled into my bag between two trees.

Planned Event

An O-1A departed an east coast base one Sunday morning to participate in a static display of military aircraft at a nearby civilian airfield. A few hours later, the aircraft was a wreck. The pilot was dead and his passenger was nursing a broken leg in a local hospital.

Weather was not a factor. The aircraft had been operating perfectly and the pilot had more than 500 hours O-1 flying time. What happened? Was it possible the aviation officer, safety officer, or maybe the flight surgeon let this lad down? Could he have been riding for a fall that should have been detected before this flight?

A bachelor, Bob had 8 years of military service, including combat duty in Korea. He owned and flew a personal aircraft as well as flying for the Army. He loved flying and was considered the hottest pilot in our unit.

Bob had been dating a young lady who was also an enthusiastic pilot. In fact she operated a small civilian flying service. I'm sure it comes as no surprise that he was killed at the end of the runway on her field.

If you left the base and flew for 45 minutes on a heading of 045°, you'd fly right over the spot where the accident happened. I know because I'd flown there with Bob a short time before. He asked if I minded if we stopped there for a few minutes. I had no objection. I was just along for the ride.

And I had a ride! For an approach, he flew the length of the field on the center line at 120 mph. Our altitude was 10 feet! As we approached the north end of the field, he pulled up sharply to about 100 feet, did a wingover, dropped flaps, and wheeled us onto the ground. I understand this maneuver is sometimes known as the widow maker. I can understand why!

I'll have to admit it was as smooth as silk and very impressive. But this was the same maneuver he was trying when he met his death.

Two weeks before the accident, the young lady who owned the civilian field requested, through channels, that Army aircraft participate in an airshow she was planning. The aviation officer approved her request, with the stipulation that Army aircraft would be used only for static display, and would not, repeat, would not, be used in any flight portion of the program.

Who do you think was selected for the mission? Bob, of course. It was determined that three O-1s would participate in the static display. Bob picked two of his friends to fly the other two aircraft and told them that, even though they had been told that they were not to fly in the airshow, it would do no harm to buzz the field on the way in. He told them to break right and left and he would break straight ahead and land first. The other two were to follow in turn.

At this point, even though they had not left the ground, the accident was inevitable. It was a PLANNED EVENT. As they approached the field, one of the last things that Bob ever said was,

"Hold it in tight and we'll give them a good show!"

A large crowd was on hand to watch the performance and Bob really gave them a good show. He put the Bird Dog through its paces. But in his eagerness to please the crowd, he pulled the aircraft up a little too steeply after his low pass. As he did the wingover and dropped flaps, the aircraft stalled. It started into a spin to the left. Bob stopped the turn and pulled the stick back. But there just wasn't enough room to recover. The aircraft hit the ground and came to rest on its nose.

Fortunately, the passenger in the back seat suffered only a broken leg and was out of the plane immediately. The aircraft didn't burn and Bob was pulled from the wreckage within seconds. But this happened in the days before Army Aviators wore helmets and Bob had a severe head injury. He died three hours later in the local hospital. I don't think he ever knew just how much he impressed the crowd that day. Investigation revealed that if the aircraft had been 20 feet higher, Bob probably could have recovered safely.

Can you see the chain of events that led to this accident—the feeling on the part of the pilot that he was really the master of the O-1A; the error on the part of the operations officer when he assigned Bob this mission when it was general knowledge that Bob and the young lady were more than friends; and finally Bob's complete disregard of orders? Yes, I think we can safely say that this accident was a PLANNED EVENT.

Slightly Disoriented

Several years ago, an Army Aviator flying a U-8D became lost in northern Laos while on a flight from Luang Prabang to Nam Tha. The flying time from Luang Prabang to his destination was approximately 45 minutes. Three hours and 30 minutes later, this pilot landed back at Luang Prabang without making a landing any place else. Why?

It boils down to flying time and distance to a point. Not finding that point, he circled and flew up and down valleys trying to find the Nam Tha airfield.

At 14,000 feet, forward visibility was unlimited. But due to the "burning of the mountains" as described by Dr. Tom Dooley, vertical visibility was greatly limited. After wandering over northern Laos, northeastern Burma, and possibly southeastern China, the pilot arrived back at Luang Prabang by picking up an indication on his homer. It was the only thing he did right all day.

A year later, I did it again! This time I had been into the destination strip the day before. I felt kind of proud because I was the first Army Aviator in this area. The flight went like this: I departed Danang, Vietnam, for a short flight of 15 minutes to Hue. The weather conditions were favorable, so I followed the coastline until I picked up the Hue nondirectional beacon and then flew

to the field under broken to overcast cloud conditions.

At Hue, I picked up five passengers for the U-6. After fitting their parachutes, we departed for A Shau, a jungle outpost on the Laotian border. A Shau was only about 40 minutes flying time, but as it turned out, we were in the air well over 3 hours.

As we departed Hue, I climbed to about 12,000 feet to the east from sea level to get above the weather. I then reversed my course to pass over the Hue nondirectional beacon on an outbound heading to A Shau. After 40 minutes, I descended in a clear area and tried to find the strip.

The weather in the valleys below was clear but I couldn't find the strip. Giving it the old college try, I kept looking until I felt it was time to go home.

I climbed to 11,000 feet, heading toward Hue, then suddenly found myself under instrument conditions. I was unable to go below safely and unable to get any more climb out of the Beaver.

I stayed on my heading on instruments and requested an instrument clearance to Hue. I could not contact Hue, so I took up an east heading for Danang. The nondirectional beacon at Danang was stronger and the tower operators always seemed better.

After getting an instrument clearance to Danang, the only worry I had was fuel. As it turned out, we arrived at Danang with one empty tank, one tank indicating empty, and the other tank indicating 4 gallons.

From now on, I fly by these two rules:

1. Have a definite turn-around point or turn-around time on all flights into unknown areas.
2. When operating over jungles or mountains, carry the maximum fuel, even if it means leaving a passenger behind.

Old Chinese Proverb

He who asks a question is a fool for five minutes. He who never asks a question is a fool forever.

Thought provoking, isn't it. Amazing how smart those old Chinese were. Let me tell you how I might have been a fool forever....

The Navy has the philosophy that the best flight surgeons should be close to the aviator, should understand what an aviator has gone through to get his wings, and what he has to go through to fulfill his mission. Consequently, part of the training for flight surgeons at the Naval School of Aviation Medicine, Pensacola, Fla., is basic flight training, up to and including solo if the flight surgeon qualifies.

My instructor was a Navy lieutenant who had completed the Naval Cadet Course, an 18-month period of intensive training in all phases of flight. After earning his wings 6 years ago, he had been assigned to various squadrons and, in the process, had made 384 carrier landings (which he referred to as "a few less than 400"), about one-third of which were at night. To anyone who has made any carrier landings (or for that matter seen them), this is quite a recommendation of a pilot's skill and knowledge. My instructor's most serious accident during all that time consisted of blowing a tire. In addition, since coming to the training squadron, he had the best record of any instructor in paperwork errors. In fact, he had a total of none.

To me, these are the qualities an instructor should have—knowledge, skill, and meticulous attention to detail. For, as all those who fly know, the small details left unattended may soon "snowball" you right into the deck. And it is invaluable to the student's future proficiency to have these qualities instilled into him early.

The morning of my hop (three hops before solo), my instructor was taking me up for my presolo checkride. We were unable to leave the deck until about 1030 hours. Since the usual length of a hop was 1.3 hours, we wouldn't return until nearly 1200 hours. This had a lot to do with my story, as you will soon see.

Two days previously, one of the instructor pilots and a student had been killed in a crash. The funeral was to be the afternoon of my 10th hop. All flights had to be back by 1200 hours to allow everyone to attend the funeral.

In a training squadron, instructors are always pushed for time to fly all their students. Consequently, every available chance is used to get students in the air. This squadron was no different. My instructor was trying to get all three of his students flown that day, as were all other instructors. I happened to be last on the list.

We took off about 1030 hours on runway 22. My instructor, having rushed all morning, was anxious to get to the area as soon as possible and allow as much time as possible for my instruction. There was more than the usual rush this day due to the 1200 deck call.

After completing the assigned instruction out in the area, we turned and headed for home just in time to get back on deck by 1200 hours. Due to the time limit and similar instructional situations, many others were doing exactly the same thing. As we approached the field, we could see for quite some distance that planes were stacking up in the pattern. And since we were rushed, my instructor said, "I'll take her in. We're pushed for time."

This, of course, was logical, due to the heavy concentration of planes in the pattern, all of them in a hurry. He was eminently more qualified to bring it in than I. (And they always appeared to be touching my wing even when there were only two of us in the pattern.)

However, while we were entering the pattern I noticed that all didn't seem just right. I noticed that the duty runway had been changed from 22 to 18 in our absence. The pattern was under semirigid tower control due to the large volume of traffic; i.e., one doesn't have to get a clearance to land as long as he conforms to field regulations. Therefore, normally, one observes from the air what the duty runway is and there is no communication with the tower.

Well, the farther we got into the pattern, the more obvious it became to me that our goal was not runway 18 as it should be; rather it appeared we were going to end up on runway 22, which is where we took off. By this time, we had come fairly close to at least two aircraft in the proper pattern, and my instructor commented that they must be solo students.

Well, have you ever been with someone whom you personally thought to be an expert in doing the thing you were observing, and watched him do something you didn't think was quite right? You wanted to comment or ask a question. Yet you held back for fear of "being a fool." You knew his excellent qualifications and were equally as aware of your inferior ones, so you remained silent, trusting that you would see the wisdom of it all in a few minutes. I did exactly that for a few moments—moments which could very possibly have made me "a fool forever."

Finally, I asked if he hadn't made a mistake. He immediately saw his error and made the proper adjustments. Being the excellent instructor and gentleman that he was, he did not reprimand me for questioning his judgment, but was appreciative that I had asked. After landing, he was truly amazed that he could have made such a simple mistake.

It might seem odd to some that such an excellent and experienced aviator could err this way. But if we examine the situation closely I think we can see why. I believe it was a compilation of pressure points!

1. He was a very dedicated instructor who was trying to do the best possible with what was available to him.
2. A fellow pilot had been killed only two days before, and he was to attend the funeral that afternoon. (Some might say that they could completely eradicate this from their thinking, but I doubt it.)
3. He had to have the plane back on the deck by 1200 hours—three hours earlier than usual.

These major pressures plus the innumerable small harassments which occur to everyone daily, I feel, caused this qualified aviator to rush to the point where he erred in his assessment of the situation.

What Price Experience?

You are a newly rated rotary wing aviator, junior first lieutenant, and newly qualified in the OH-13. You are about to take part in a field maneuver as a member of an armed helicopter unit.

The flight commander walks into the operations shack 15 minutes late for your initial briefing. He pitches his cap on the table and in a barely audible voice gives his briefing: "Okay, you guys, off at 0700. Check your ships and watch your gear. I'll lead. The UH-19 will follow. We'll refuel at Fort Mac. See you tomorrow!" He picks up his cap, starts to leave, then turns back. "Oh, yeah, scrounge up some maps. I don't have any!"

You glance around after he departs and notice the general impression is that all pilots were informed of something—exactly what, remains hidden in a sort of haze. Your feet are planted

firmly in mid-air. You have received your meager diet of information, digested it, and are ready to launch yourself into the air the following morning.

Takeoff at 0700. Some confusion but no real sweat. All aircraft settle into some kind of "Vee" formation after a few moments of shuffling back and forth. Weather appears to be a serious problem for the flight. But you remember your flight leader said earlier, "No problem. We can get down to treetop level and cruise there."

As your flight progresses, you discover visual references diminish to the point where you can only see down and ¾ of a mile horizontally. You see OH-13s to the right and left, and a couple more ships in front. Your lead aircraft is not in sight, nor is the UH-19 chase aircraft which is supposed to be located somewhere behind the flight. Your wristwatch tells you that you have been in the air 40 minutes.

Approximately 20 minutes later, a dark shape with flashing red and green navigation lights slips by your helicopter off to the right about 300 feet, followed by one, two, three, then four, and five more helicopters.

Assuming they are all part of the flight, you shove the cyclic over to the right and take off in hot pursuit. You don't want to get lost.

Sensing possible radio failure because you have not received turn-around instructions, you try the radio to confirm your progress. Your flight leader comes back loud and clear, "Yeah, we're going back. Can't get over the mountains up there."

"How about a fuel stop?" you ask.

"No sweat," he replies. "We'll have to go all the way back. I forgot the credit cards."

Great Caesar's ghost! No fuel stop and you have less than a quarter tank of fuel remaining and only 50 feet of gray murky air between you and the pine trees!

You take a hitch in your pucker string and fly on.

One of the ships calls over the radio that he is landing due to loss of oil pressure. Another goes down because of a rough running engine. A third lands with low fuel. In less than 8 minutes, six helicopters go down for various reasons, including two that are lost.

Seven of you remain, plus the UH-19 chase ship. As the tension increases, and small fingers of panic begin to clutch you, you turn to the crew-chief for some measure of assurance and ask about the accuracy of your fuel gauge, which is beginning to nudge the edge of the empty line. He tells you the empty mark means exactly that —empty!

Panic begins to subside and training procedures dominate your thoughts. You begin to scan the area below the line surrounding your helicopter bubble. You pray a little, "Please, just one more minute of fuel!"

Suddenly there is silence. An eternity seems to pass between the indication of engine failure and your response. You bottom the collective, establish forward airspeed, hold the right pedal in, and head for your landing spot.

So far so good. Only one problem remains—that four-strand high tension line that runs perpendicular to your selected landing area.

You crack the collective just a little to bring the ship up a little, and ease her over the wires. This drags your rotor rpm down and forces you to make a hard running landing.

The area is very small. As you touch, you drop the collective and let the weight of the aircraft stop forward motion. You cut the switches, turn the fuel off, and try to relax.

After your forced landing, three other helicopters go down in the same manner. Fortunately only one is damaged. Four aircraft make it home, including the UH-19.

Your immediate reaction is one of relief, coupled with disbelief. Then you think back over the flight and begin to vent your ire on the flight commander.

But was it the fault of the flight leader entirely? No, it was not. All of you were responsible for accepting the flight in its initial form, and still more to blame for not demanding explicit instructions about the flight.

No point trying to shift the blame to one individual because of his leadership position. All aircraft have certain designed capabilities. *You* must measure aircraft ability in definite and absolute terms, and it is your duty to know your aircraft limitations, to evaluate your own capabilities, and operate between these two areas.

Operations Officer

As operations officer of a busy airfield, an aviator piles experience on experience until he thinks he has had everything happen to him that can happen. Then comes a call from the tower: "Aircraft in trouble!"

At 1800 hours, my home telephone rang. It was the night dispatcher.

"Sir, we've got a U-8 in trouble."

I drove to the airfield, where my operations sergeant was waiting. The U-8 was circling with a fouled nose gear. I learned that the pilot was our flight examiner and, incidentally, one of the best Army Aviators I knew.

In the control tower, I contacted the aircraft. The pilot told me he had dropped his gear for landing, heard a loud bang in the nose section, and could not get a positive down indication. A fuel check indicated approximately 3 hours of fuel aboard.

We wanted to see what the nose gear looked like. I called the fire department and told them to meet at the runway intersection with a fire truck. The airfield was equipped with an alert jeep with VHF, so I could talk to the tower and the aircraft on omni. But without UHF, I could not receive the aircraft.

We arranged this communication system: jeep to aircraft on VHF; aircraft to tower on UHF; and tower relay to jeep on VHF.

By this time, several people had gathered at the airfield out of curiosity (Army grapevines really work). I needed some kind of control, so I asked the Military Police to send a detail to keep the curious out of our way.

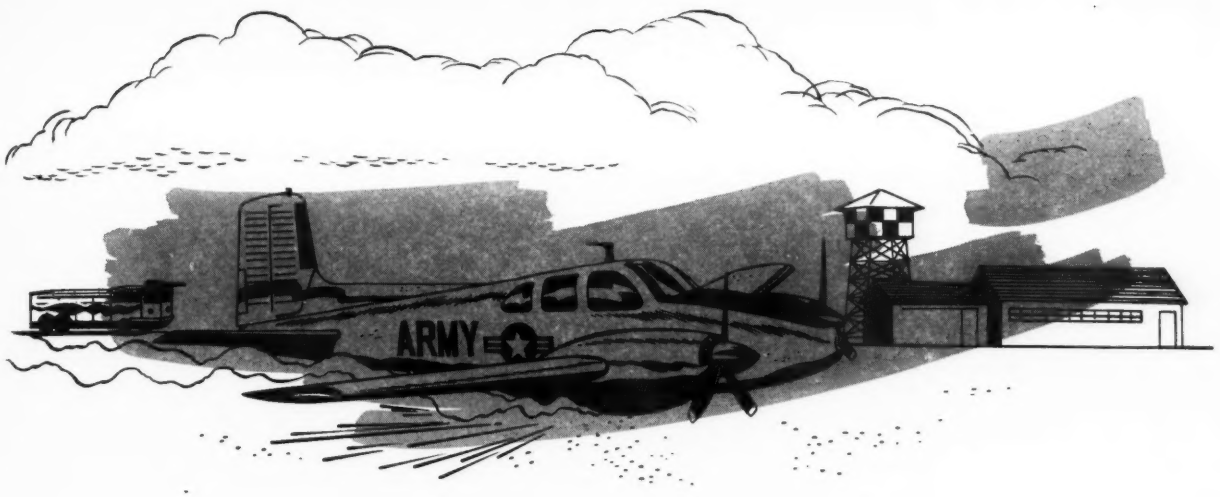
I planned to have the aircraft fly down the runway at an altitude of about 20 feet. Using the spotlight on the fire truck, I hoped to see what the nose gear looked like. This was acceptable to the pilot, so we started the operation. The fire truck was on the north side of the east to west runway, so we had the pilot pass from east to west to lessen the chance of blinding him with the light.

Three passes were made. Each time it looked like the nose gear was extended all the way. But we weren't satisfied. We decided to place two fire trucks, one on either side, approximately one-third down the length of the 3,000-foot runway. These trucks were placed in position with their floodlights aimed down the runway. The pilot was directed to make a high speed touchdown on the main gear just before reaching the lights, then touch the nose gear down and immediately execute a go-around. Bear in mind that this was an exceptionally good pilot.

With the trucks lighting the runway in the direction of landing and the aircraft landing lights, I hoped to be able to see the nose wheel touch. The pilot landed in exactly the right spot. Looking from behind, I could see the nose gear and wheel perfectly under the wing. As the nose wheel touched, it swung violently in an arc of approximately 60°-90°. The pilot immediately poured on the coals and took it around.

Now we understood our problem. I offered the pilot his choice of landing or going to a larger field. We knew it would be wheels up, so I felt he should make his own decision about where it would be.

As I expected, he decided on the larger airfield. My job then was to find an airfield within one hour's flight time that would accept a wheels-up landing. An international airport located 5 miles away accepted, but said it would be better if we could find another field because they had considerable commercial jet traffic.



I then contacted a nearby Air Force base and was told they could accept the U-8 in about 1½ hours. They had some F-104s returning with low fuel and had to get them down. So this choice was out of the question because of the fuel then remaining.

My next choice was a Naval air station. Their answer was, "Yes. When will he arrive?"

They said they would give him a DF steer with a GCA handoff, and all crash and rescue equipment would be standing by. This sounded wonderful, but why the DF and GCA? Then I learned that they were at GCA minimums and forcast to drop lower. This ruled out the Navy.

My next choice was a private field owned by an aircraft manufacturing company. When I contacted their control tower and told them of our problems, they invited us to be their guests. So our aircraft departed for the airfield.

Their control tower kept one operator on the telephone throughout the landing, telling me what was happening. Crash equipment was standing by, but fortunately it wasn't needed for the landing. While on base leg, the pilot feathered one engine and turned his prop with the starter to a position that would minimize any damage to the prop blades. On final, he did the same with the other engine and dead sticked it in. After rolling along on the retracted landing gear, he braked to a smooth stop.

The next day, the aircraft was jacked up, gear extended, nose gear locked in place, and flown to the field maintenance shop for repairs. The damage amounted to fifty dollars.

Similar emergencies are continually arising around the world, wherever we have aircraft. After nearly every one, there's an operations officer who breathes a sigh of relief and gets ready for the next one.

Jim, Jack, Bill, and Tom

Jim made a thorough inspection of the armament system mounted on his OH-13. Later that morning, he was to demonstrate a firing run for a group of spectators.

He left early to get in some low-level flying practice on the way. This flight offered no excitement because he'd flown over the same area many times before. Skimming over the terrain, he crossed a deep ravine. Almost without thinking, he dipped down to follow this new and more exciting flight path.

Jim knew the ravine could prove dangerous, so he kept a sharp lookout. Sure enough, in a few minutes he spotted wires ahead. They were strung fairly high and he decided to fly under them.

The Sioux passed under the high wires with room to spare, then hit a second set of wires that were lower and much less conspicuous. The crash caused major damage. Jim escaped with minor injuries.

Jack was admired by all his fellow instructor pilots. He flew as though he were a part of the machine. All helicopters seemed to perform better with Jack at the controls. His only fault was an occasional show of impatience.

We were practicing a flyby with a large number of aircraft. Timing was critical to get each air-

craft to pass in front of the spectators at exactly the right interval.

As usual, Jack's timing was perfect on the first try, but it was obvious some of the pilots needed much more practice. We made several more runs. After each, Jack flew to a small open area and practiced maneuvers until we were ready for the next run.

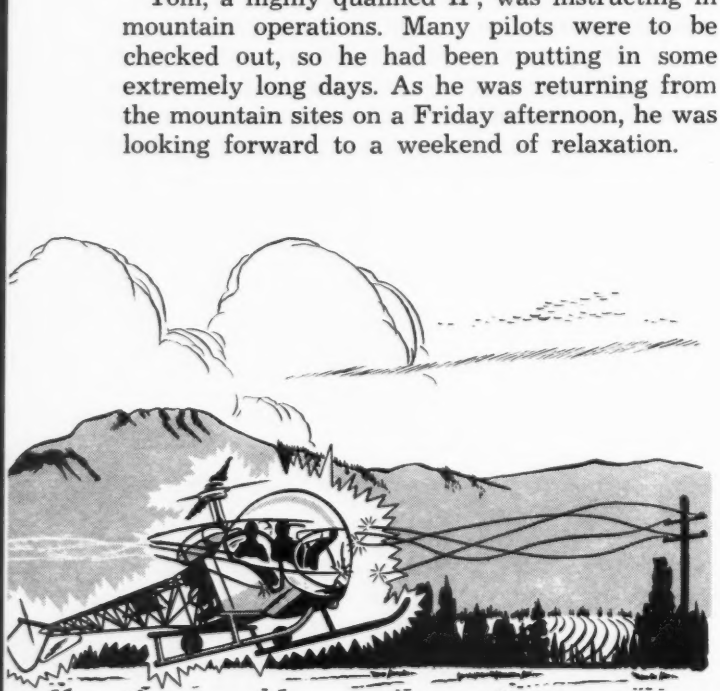
Changes in the script and poor timing by several pilots caused our rehearsals to run for several days. Jack was obviously displeased. He became restless and took unnecessary chances, flying extremely close to all obstacles in his flight path. This didn't attract the attention it should have because everyone expected him to be spectacular.

The day of the demonstration finally came. Jack took off and flew to his checkpoint as he had done many times. He crossed the highway on his normal flight path. But this time he was a few inches too low. His right skid caught under a heavy telephone cable. The helicopter flipped over and crashed. Jack survived, but his injuries ended his flying career.

Bill had more helicopter flight time than all the other pilots in our unit. After completing a test flight, he decided to give the crewchief a close view of the local scenery.

He swooped down into a valley along a river and immediately struck a wire. It sliced off the top of the bubble and caused other major damage. Fortunately, he was able to recover and land.

Tom, a highly qualified IP, was instructing in mountain operations. Many pilots were to be checked out, so he had been putting in some extremely long days. As he was returning from the mountain sites on a Friday afternoon, he was looking forward to a weekend of relaxation.



Three heavy electric cables were draped from two mountain peaks across a small valley in Tom's flight path. These cables stretched for approximately ¾ of a mile. He had flown over and under these cables many times. But as he was flying home this late afternoon, looking into the sun, he flew directly into them. The cables stopped the forward motion of the helicopter and it crashed to the valley floor in a heap of junk. Through a miracle, both pilots lived and Tom was back on flying status 18 months later.

Four wire-strike helicopter accidents. Four highly qualified and experienced pilots. Each pilot knew of the presence of potential wire hazards:

Several poles were visible and should have tipped Jim off about the second set of wires, but he was concentrating all his attention on the first set of wires and failed to see them.

Several factors contributed to Jack's accident. He had serious marital problems which caused him mental anxiety. And prolonged practice of a comparatively easy demonstration added frustration to his anxiety. He flew in a manner that would tax his ability to the limit as a release from built up tension. Leaving no margin for error, it only took one second of undivided attention to cause his accident.

Bill had been watching for wires. He spotted a small road crossing the river, frequently a good clue to the presence of wires. But the position of the sun obscured the telephone poles and he never saw the wire he hit.

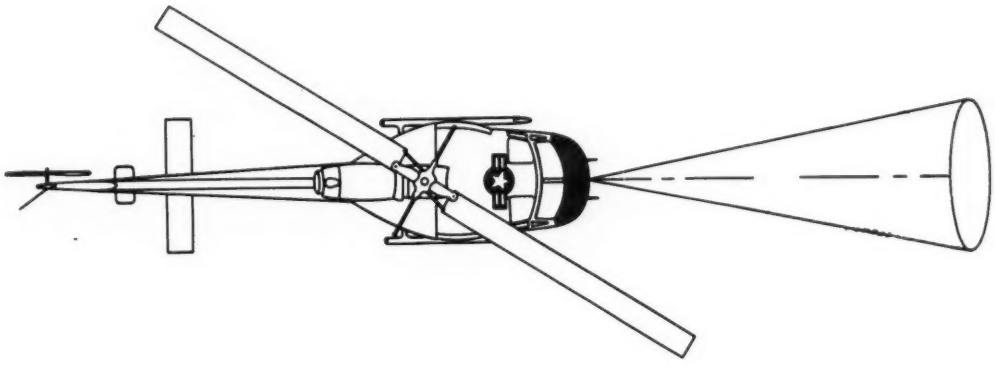
Tom had seen the cables he hit many times before. The powerline towers were visible for a considerable distance along his flight path. But looking into the sun, probable fatigue, and possible preoccupation with thoughts of the coming weekend were enough to cause a moment's distraction at a critical point in his flight.

These are typical of the wire-strike accidents that present a major problem to Army Aviation in nap-of-the-earth flying. The solution is not yet in sight. An electronic device, using LASER light shows great promise [see "Now You See it," page 45.] In the meantime, all of us need to be wire conscious and aware of the signs that indicate wires. Some of these are: telephone poles, light poles, towers, or antennas; areas where trees or brush have been cleared; isolated buildings; roads and trails crossing streams or valleys.

Contour or nap-of-the-earth flying should only be attempted when you are at the peak of physical and mental alertness. And you should always avoid flying directly into the sun.

Laser Light Electronic Wire Detection . . .

Now You See It!



Ted Kontos

A UH-1B HAULING passengers on a routine flight suddenly struck cables. Supported by huge metal towers, the cables were more than 1½ inches in diameter. Three occupants were killed.

A pilot flying an OH-23B landed and hovered back and forth across a field. He then tried to take off and crashed into wires stretched across the same field.

These and the majority of wire strike accidents have two things in common: They occurred during daylight hours under conditions of good visibility, and the types of aircraft most frequently involved were helicopters.

During the past five years, similar accidents claimed 21 lives and cost $3,250,000 in aircraft destroyed or damaged. They cost a great deal more in anguish and failed missions. And wire strike accidents are on the increase.

Are these accidents unavoidable? Is this a penalty rotary wing aircraft must pay? The Army doesn't think so. In fact it has already done considerable research in an attempt to halt this waste of personnel and equipment.

A better safety program has been initiated with emphasis placed on the need for pilot alertness and more concentrated observation during flight. This has met with little success because the helicopter pilot finds himself under constant pressure. During critical periods of flight, he is kept busy manipulating flight and engine controls, while simultaneously monitoring an array of instruments. This leaves little time to search for obscure objects that may lie ahead.

One answer appears to be modification of the pilot's cockpit. A better designed flight compartment with cleaner instrumentation and control systems would allow the pilot more freedom. Undoubtedly, this would be an improvement, and such a design is sorely needed. But even if it were available, it would not be the final solution.

For example, in the first accident we described, investigators, flying the same route and knowing the location of these large cables, were unable to detect them.

In the second accident, the pilot passed under the wires twice while hovering back and forth prior to takeoff. Yet, he failed to notice them.

To allow the pilot more opportunity to sight obstructions, it is clearly evident that a cleanup of the cockpit is necessary. But, as pointed out, this must be supplemented by additional means of wire detection.

Toward this end, USABAAR initiated a wire marker program.

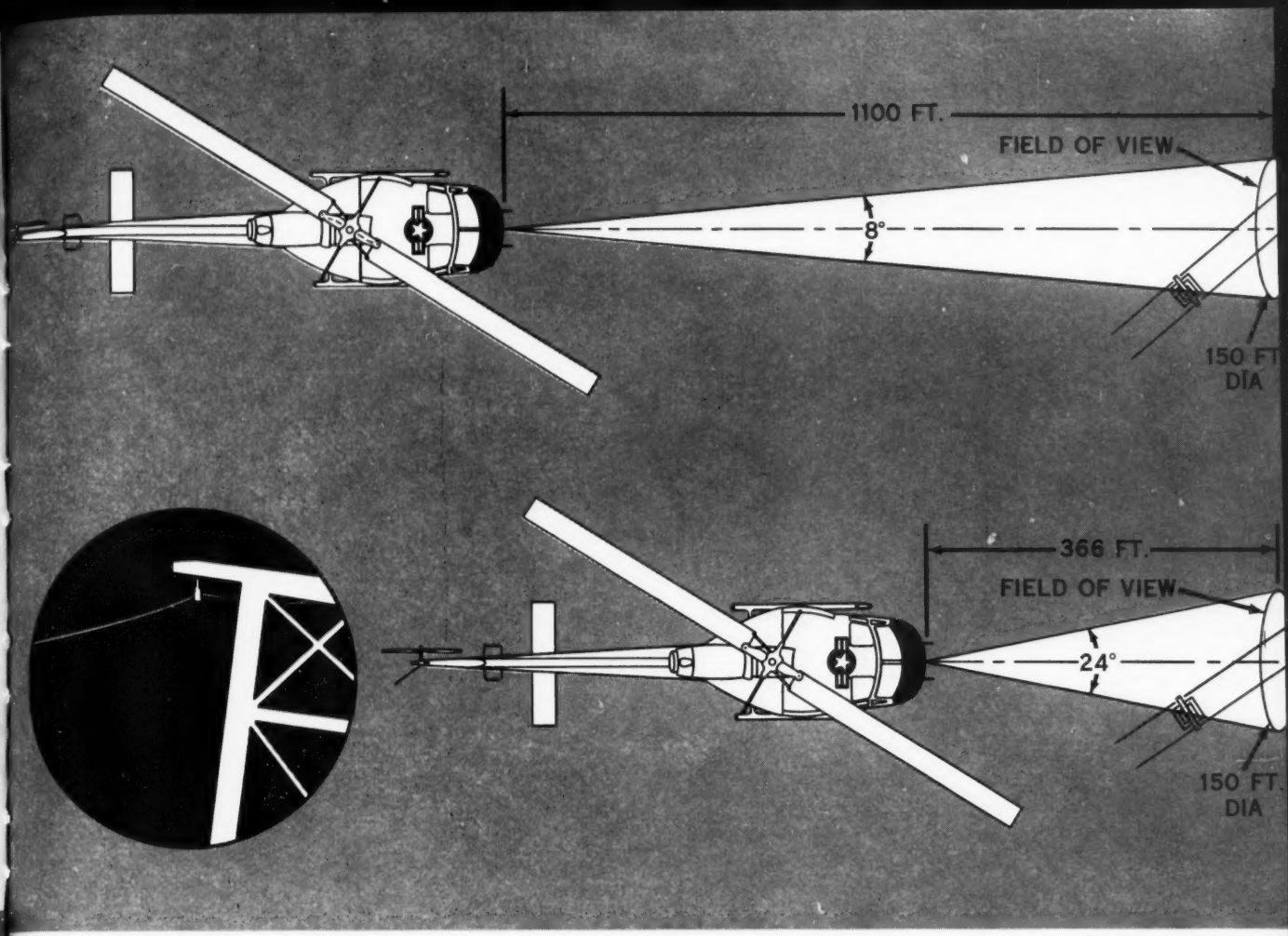
The idea was to string markers on cables and other obstructions throughout the country. These were to be designed and colored so they would be easily spotted from any direction of flight. They were to be constructed from materials having the ability to resist the elements. After a great deal of experimentation, the project was abandoned.

Assuming the markers were satisfactorily designed and manufactured, their placement on thousands of miles of cables, pipelines, and the like would be a monumental task. When we consider the additional construction always going on, the task becomes all but impossible. Furthermore, these markers could not be seen at night. Nor would they be available over hostile territory where cables might be intentionally strung by the enemy. This was not the solution.

The field of electronics was not overlooked. Because of cost, weight, limited light level and resolution, relative ease of jamming by enemy forces, and an undue amount of concentration demanded from the pilot, radar has not yet been able to produce a satisfactory solution effective for Army helicopters. For a time it seemed that no answer was forthcoming. Then, a ray of light literally made its appearance and brought new hope. This light is known as LASER—*light amplification by means of stimulated emission of radiation.* Although barely three years in existence, it has been subjected to research in a variety of fields.

It has been successfully used to televise subjects, carry telephone conversations, and even to cut through the steel armor of a battleship. Laser rays capable of destroying or rendering enemy missiles inoperative fall within its scope. Toward this end, the United States Government currently has awarded nearly $1,000,000,000 in contracts. Soviet Russia is known to be making similar research.

What, then, is this thing called "laser"? Basically, a laser unit consists of a tiny core or rod, usually made of a synthetic ruby. A spiral flash lamp is wound around it. As the lamp is flashed, somewhat like a strobe light used in photography, chromium atoms in the core become excited. This excitation causes them to emit powerful bursts of pure light. The light beams produced in this manner are coher-



ent; that is, they are all of the same wave length. Because of this, they do not dissipate as does incoherent light. Consequently, laser beams produce a light brighter than that in the center of the sun. One end of the ruby core is silvered to force the manufactured light out the opposite end.

How is laser related to wire strikes and helicopters? Autonetics, a division of North American Aviation, Inc., of Anaheim, Calif., has done some remarkable research in this area. It has developed a helicopter obstacle warning system (HOWS) that operates on the laser principle. This unit continuously emits a beam of light ahead of the aircraft and picks up any objects illuminated by it. It then projects these images on a circular screen of the receiver where the pilot can view them.

In a recent static test, photographs were made of a broom handle 1.3 inches in diameter having a quarter-inch steel cable secured to it at a 45° angle. These pictures were made from a distance of 93 meters, using both natural light and laser illumination. Results showed that the photographs taken with laser were of much better quality. The researchers were somewhat amazed, as the test was conducted outdoors during a moderate rain.

Let's see how a present day system would work operationally. A pilot in a laser equipped helicopter prepares to make a daytime takeoff. Ahead of him are powerlines that are not discernible because of background clutter. His laser unit is turned on but no image appears on the circular screen of his receiver. The pilot does not monitor this screen but concentrates on performing all the normal functions necessary for flight.

He is so preoccupied with controlling the aircraft and viewing his instruments that he does not see the cables as he approaches them during takeoff. But, as he comes within a predetermined range, an audible warning device sounds off. Quickly, he glances at his scope. Here he sees their image projected on the screen in relation to the aircraft's position. He can see whether he must go over, under, or perhaps abort the takeoff to avoid a strike. And he has sufficient time to take the proper evasive action.

The system would have functioned just as effectively at night. It would have given him a similar warning regardless of the nature of the obstruction.

This, of course, is the primary purpose of a laser device installed in a helicopter. The same aircraft could also employ this system for drop zone or landing area identification. The use of similar systems as range finders is already a reality.

Presently, this system adapted to helicopters can function under a .5-g vibration at rotor frequency and under a 4-g load. It can operate effectively throughout a temperature range of −40° F to 140° F.

During flight at low airspeed, its range decreases while the field of view becomes greater. At higher speeds, the range is increased with a corresponding drop in field of view. This allows the pilot an equal amount of time to react, while giving him broader coverage at lower speeds.

The laser unit transmits 3 megawatt pulses at the rate of 10 pulses per second. It illuminates everything in range, while blocking out any solar interference, and provides both an audio alarm and video display. This leaves the pilot free to perform other duties until some obstruction threatens. The system can detect a quarter-inch steel cable at a distance of 400 meters.

This unit is not merely in the development stage. It is a reality; production models can be delivered sometime in early 1965. Production cost is not known but estimates place it around $25,000.

Since it will be able to operate from current available on present aircraft no modifications will be necessary on these aircraft systems. The present screen size is 3 inches in diameter and represents a viewing area of a 150-foot diameter circle. The total weight of the system is 50.3 pounds and a volume of 2 cubic feet is required to house all components.

Installation can be varied but the present proposal is to house the transmitter in the nose of the aircraft. Since the system operates on the principle of light and covers a rather confined area it is less subject to enemy jamming.

The system is not without its disadvantages.

Because the present range is limited to approximately 1,300 feet, the system is only feasible on aircraft flying at speeds below 125 knots. Although a number of fixed wing aircraft may fly below this speed, they do not have the maneuverability of a helicopter and, consequently, would require warnings from a greater distance. But it is the helicopter that is nearly always involved in this type accident. And operational speeds of present day helicopters are below 125 knots.

The second major disadvantage is that the pilot will often receive an audible warning when there is no obstruction ahead of him. For example, this might occur during low-level contour flying and during approaches in mountainous terrain. But isn't it better to get a warning when no danger exists than not to have any notice when there is such a danger?

Although the present weight and volume configuration is not prohibitive, the Army would prefer a reduction in both these areas. All in all, the advantages far outnumber the disadvantages. Furthermore, the Army's interest lies not only in what this system can accomplish now but also in its future possibilities.

What are some future applications? No one really knows, but let's project ourselves through time and visualize some possibilities:

Two planes approach each other on a collision course, perhaps at supersonic speeds. Neither makes visual contact with the other, but both receive warning in ample time to alter their courses. There is no collision, no near miss. Mountain peaks and thunderstorm areas are similarly avoided.

An aircraft is forced to ditch in the ocean at night. Laser equipped rescue planes fly at high altitudes miles apart, each one scanning the area through a special screen that enables magnification of the area viewed. Other rescue aircraft and ocean vessels are directed to the area and, by means of laser, visually spot and rescue survivors.

An observation aircraft takes off on a scouting mission over hostile territory at night. The pilot flips a switch and his entire windshield becomes a screen through which objects appear as if viewed under normal daylight. Flying at treetop level, he spots troop movements and supply areas. Laser simultaneously photographs and televises this information to the pilot's unit. Laser-equipped combat planes respond and destroy the enemy and his supplies.

Should hostilities occur, laser units aboard aircraft as well as on ships and ground installations would continuously search the skies for any signs of enemy missiles or aircraft. Should they detect any, they would automatically destroy them before any damage could be inflicted.

Dreams? Yes. Sheer conjecture? No. After all, a little over 3 years ago laser itself was just another dream.

1962-63 Army Aviation Soldier of the Year

Army Secretary Cyrus R. Vance congratulates SFC James K. Brock, Army Aviation Association of America Soldier of the Year

THE PLATOON sergeant of the 1st Aviation Company had his orders: keep 18 Caribou flyable during a 11,000-mile ferry mission to Thailand and have all but five aircraft ready to begin a 1,000-hour-a-month flight schedule upon arrival.

The sergeant first learned of his task at Fort Bragg, N. C., where his company had just arrived to help support a field maneuver. However, the company was ordered to return immediately to its home base at Fort Benning, Ga., and deploy within 10 days to Korat, Thailand.

In addition to normal routine and packing for the move, the company maintenance officer informed his sergeant that he would be faced with five mandatory modifications to be performed on all of the Caribou and either a safety of flight or periodic inspection of each aircraft.

However, the 1st Aviation Company deployed on schedule with all aircraft flyable—thanks largely to the platoon sergeant who used his extensive background in the maintenance field and demonstrated an outstanding ability to plan, organize, and expedite the business at hand.

Maintenance flyaway kits were assembled at Fort Benning for each of the four flights planned for the deployment. The sergeant anticipated maintenance problems that might be encountered during the flights and stocked the kits accordingly with parts and tools. He hit it *right on the nose.* Only one aircraft failed to complete its flight on schedule due to maintenance problems, and it needed a new engine which had to be flown from stateside.

Upon arrival in Thailand, the sergeant found that a second or third echelon maintenance capability was not available. Nevertheless he consolidated his maintenance section, and the 1st Aviation Company began operations immediately. Frequently the section performed maintenance that ordinarily would be considered on a third or fourth echelon level.

The sergeant improvised and invented. For example, the maintenance section had no provision to wash aircraft, a requirement before the 100-hour periodic inspection. The sergeant "obtained" two 400-gallon galvanized tanks and a pump. Engineers who delivered water to the mess hall daily agreed to keep the tanks filled, and the company was in business.

The sergeant fabricated a test rig that saved the company many manhours. When the Caribou's brake assemblies were overhauled, they had to be reinstalled on the aircraft before being tested. If they didn't work they had to be removed, and the mechanics started all over again. The sergeant's rig, built from parts scrounged from a crashed aircraft, enabled the assembly to be *accurately* tested before being installed.

The 1st Aviation Company's aircraft were scattered over three locations in the Republic of Vietnam and one in Thailand. When a Caribou broke down away from the home base the sergeant would communicate by radio with the downed crew. Nine times out of ten he diagnosed the trouble correctly, flew to the disabled aircraft with selected tools and parts, and had it flying in a minimum amount of time.

This sergeant is one of the chief reasons the 1st Aviation Company has been able to demonstrate so well that Army Aviation is highly effective in support of ground combat operations. As a tribute to his outstanding abilities, SFC James K. Brock has been named Army Aviation Soldier of the Year for 1962-63.

"Heartfelt wishes for a joyous Christmas and a Happy New Year to Army Aviation personnel throughout the world."

John J. Tolson

JOHN J. TOLSON, III
Brigadier General, GS
Director of Army Aviation

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